Compress

APRIL 1952

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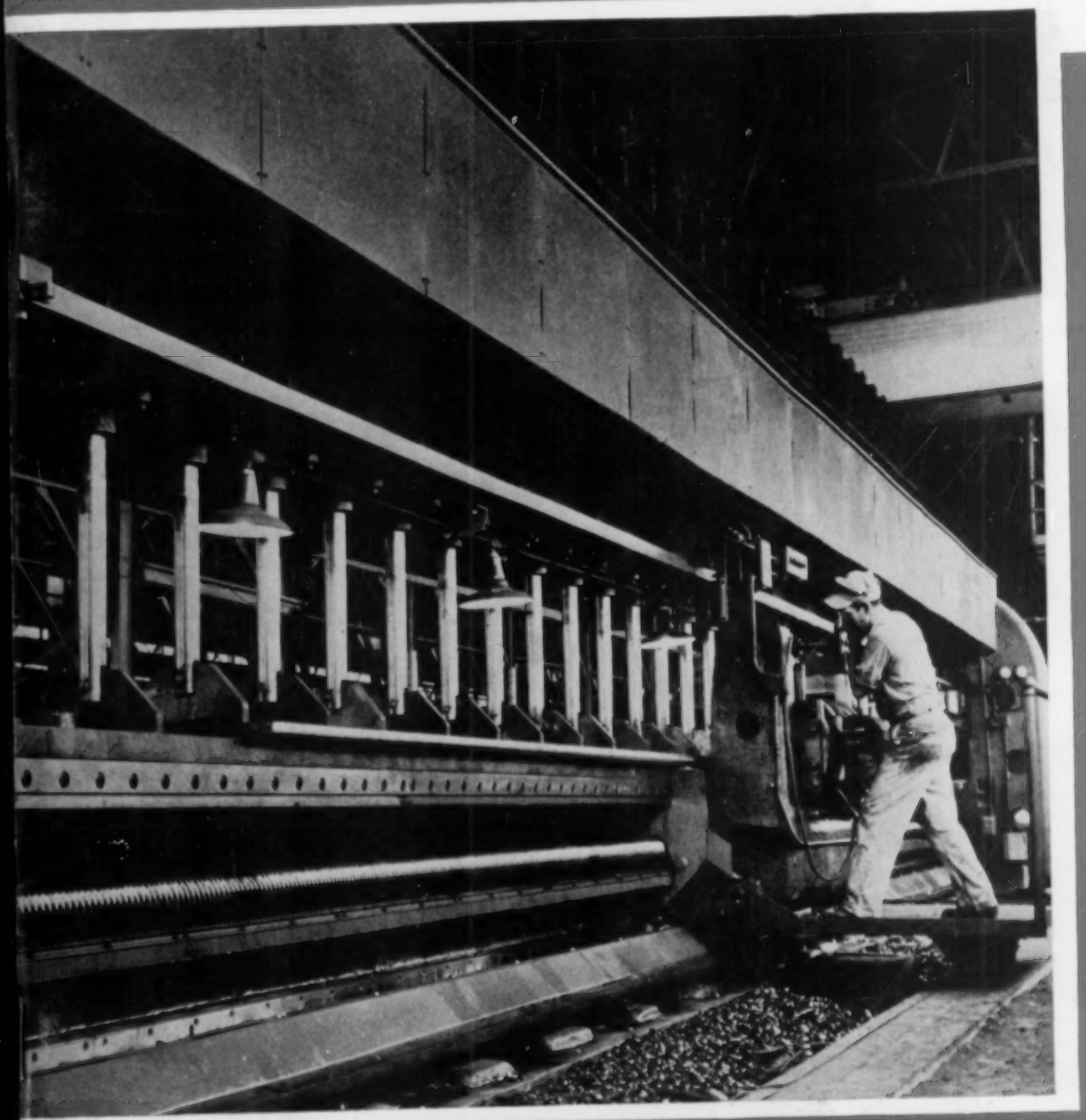


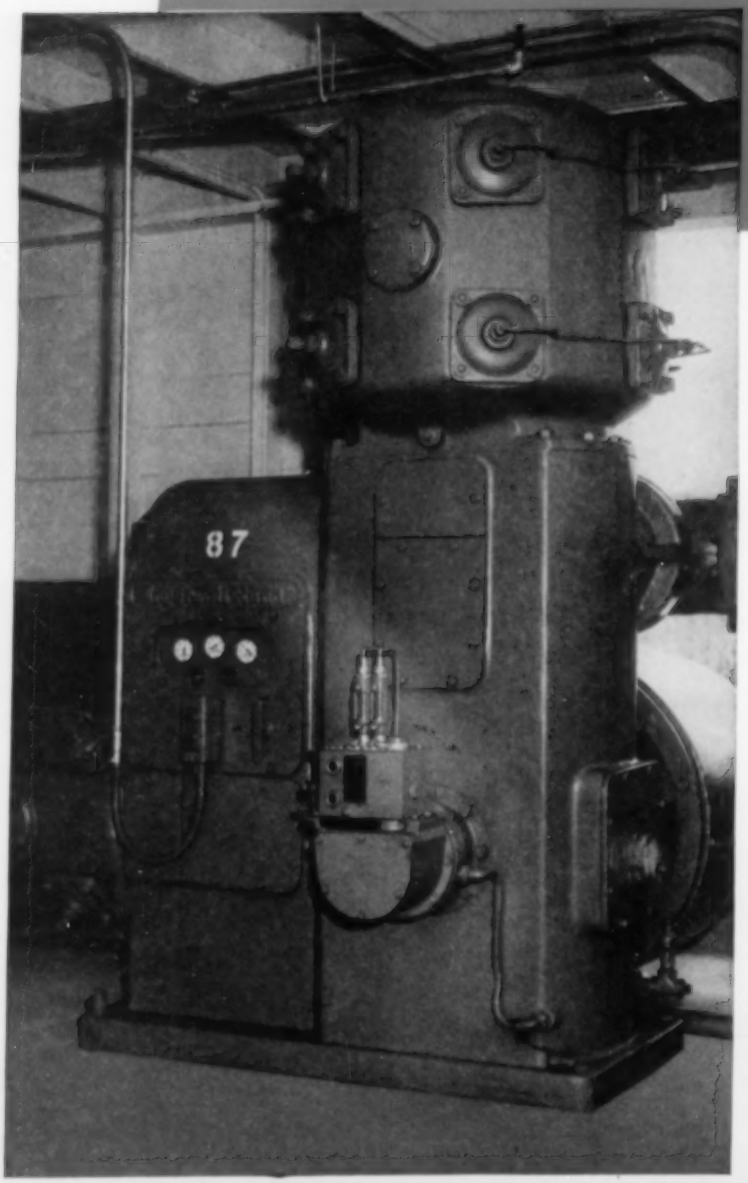
AIR HOLDS WORK IN HUGE PLANER

Steel plate 40 feet long prevented from buckling by 27 jacking cylinders

VOLUME 57 • NUMBER 4 NEW YORK • LONDON

All types of Air Compressors RUN BETTER

. . . when lubricated with the proper Texaco air compressor oil



THE TEXACO air compressor oil that will step up the efficiency of your compressors and bring down your maintenance costs is the oil your Texaco Lubrication Engineer will recommend as being *exactly suited* to your particular operating conditions. For example —

— For normal conditions, a Texaco *straight mineral* air compressor oil will be recommended. It will assure clean operation and minimum wear.

— For conditions causing rust in cylinders, coolers, lines or receivers, a Texaco *rust-inhibited* air compressor oil will be recommended. It will keep compressors and systems rust-free whether running or idle.

— For extremely severe service conditions, a Texaco *heavy-duty* air compressor oil will be recommended. It will prevent harmful formations of carbon and sludge.

— For "wet cylinder" conditions, a Texaco *compounded* air compressor oil will be recommended. It will eliminate excessive wear.

Let a Texaco Lubrication Engineer work with you to get the maximum performance from your compressors. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO Air Compressor Oils

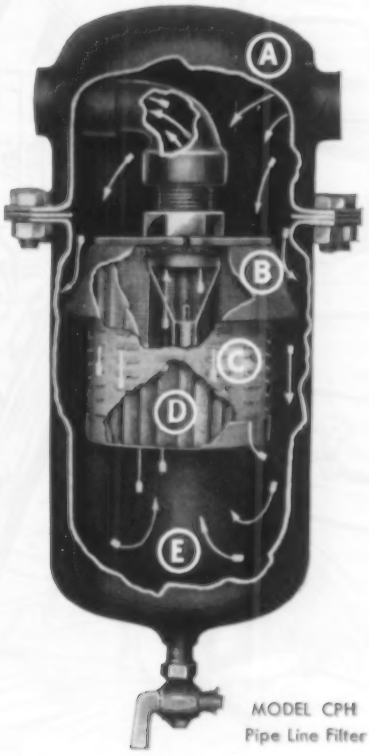
FOR ALL OPERATING CONDITIONS

Faithfully yours 50 TEXACO *for Fifty Years*

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.

Clean, Dry Air

WITH STAYNEW PIPE LINE FILTERS



MODEL CPH
Pipe Line Filter

ASSURES CONTINUOUS OPERATION OF COMPRESSED AIR EQUIPMENT

And Here's Why . . .

Air operated tools, instruments, processes and pneumatic controls have one thing in common . . . they *thrive on clean, dry air*. With few exceptions, all breakdowns, repairs, and loss of productive time can be avoided by filtering air and other gases through Staynew Pipe Line Filters. Wherever air must be kept clean and dry for industrial equipment, filter it with Staynew.

Send for complete illustrated catalog on Staynew Pipe Line Filters. Write today!

Representatives in Principal Cities

- A. Heavy pressed steel head and body.
- B. Deflector cup.
- C. Louvred housing.
- D. Radial fin filter insert.
- E. Large capacity base.

*MODEL CPH	Horizontal Pressure Type
MODEL CP	Vertical Pressure Type
MODEL CVH	Vacuum Type
*MODEL AAPH	Absorption Type
MODEL HPH	High Pressure Type

*Also available in swing bolt construction for easy inspection and servicing.

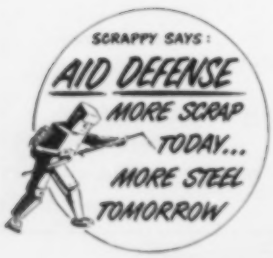
DOLLINGER REG. PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS

DOLLINGER CORPORATION

7 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

Grandpa Never Threw a Thing Away



It's only human to want to hold on to things after they've outlived their usefulness. That's why today millions of tons of worn-out and obsolete equipment and machinery are lying forgotten in the country's plants and factories and on farms.

The steel industry needs these millions of tons of dormant scrap, needs it in the worst way. With this vital dormant scrap the entire steel supply picture would brighten up, with more steel for everybody. But without it, the steel industry cannot hope to keep up production at present levels.

Call in a scrap dealer now, today. He will buy your dormant scrap and start it moving toward the steel mills.

BETHLEHEM STEEL

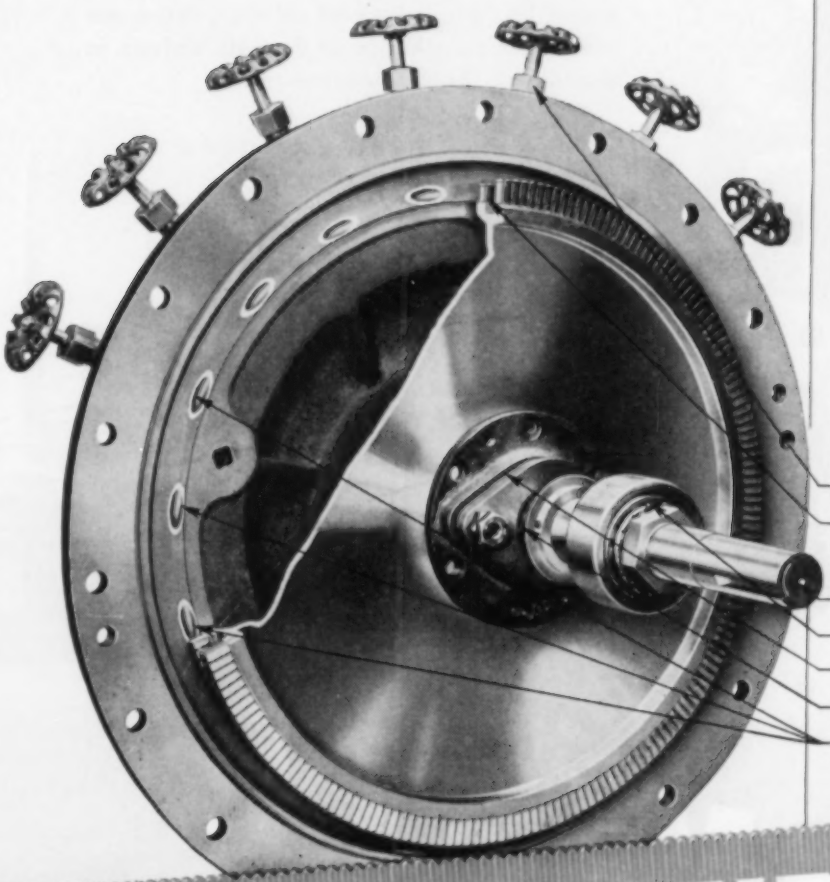
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

More Scrap Today... More Steel Tomorrow

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



7 hand valves for efficient partial load operation, (20" turbine shown)

2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced

30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open

Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP., 204 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

POWELL VALVES
are engineered to suit
the service conditions
Therefore, when you install the correct Powell Valve in a line, you are assured of long, trouble-free performance under even the most exacting conditions.
And because there's a POWELL valve for every known industrial service, there are more different kinds of Powell Valves in use today than any other make.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 1793
125-pound Iron Body Bronze Mounted Gate Valve for oil, water, gas and low pressure steam services. Sizes 2" to 30" incl.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

for EXTRA production without additional manpower

Ingersoll-Rand

CARSET JACKBITS

offer you all these time saving, labor saving advantages for faster easier rock drilling in practically every type of ground

CARSET JACKBITS WEAR LONGER—because they retain their Tungsten Carbide cutting edges after drilling many feet in the *hardest rock.*

INCREASE DRILLING SPEED 50% OR MORE—because they maintain their original high drilling speed for the full depth of the hole.

BOOST TONNAGE 20% OR BETTER—because they permit drilling deeper holes and pulling longer rounds. This means more rock or ore broken per shift.

PRACTICALLY ELIMINATE BIT CHANGES—because gauge wear is negligible and uniform diameter holes can be drilled to any practical depth.

SAVE UP TO 30% ON DYNAMITE—because they eliminate tapered holes, permit smaller hole diameters, and concentrate more dynamite in the bottom of the hole.

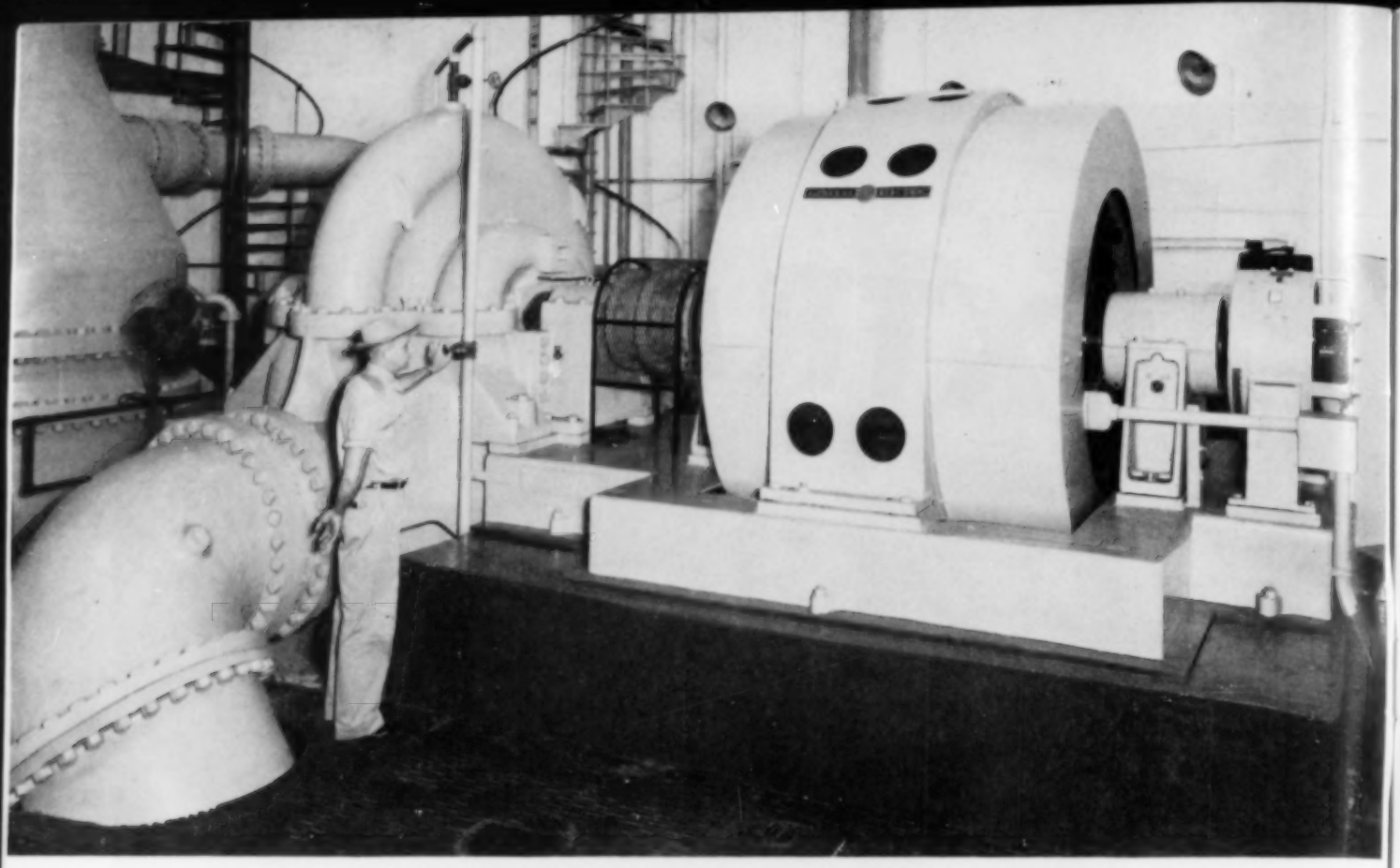
CONSUME UP TO 50% LESS DRILL STEEL—because the smaller average size, sharper-edged bits drill easier and are kinder to drill steel.

REDUCE AIR CONSUMPTION AT LEAST 40%—because they permit the use of lighter drills, smaller diameter holes and much higher drilling speeds.

REDUCE MAINTENANCE COSTS 30% OR MORE—because they lighten the load on drills and equipment, greatly extending the service life between overhauls.

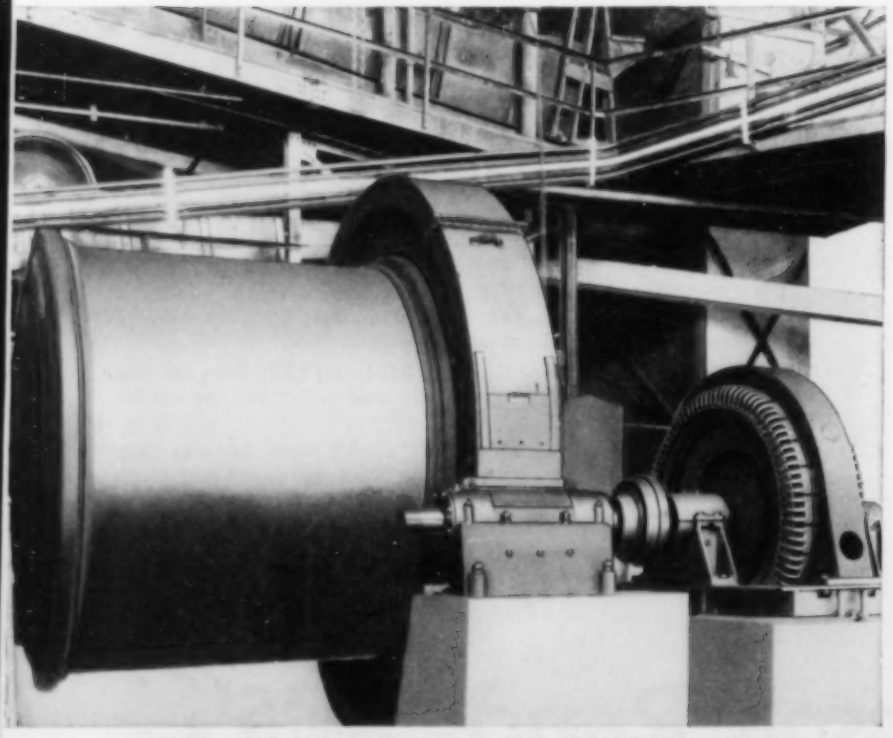
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 747-15

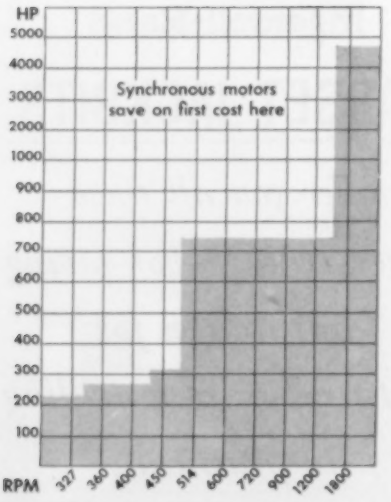


Savings in distribution equipment investment were made possible by selection of this General Electric 2500 hp synchronous motor for a municipal pumping station.

G-E Synchronous Motors

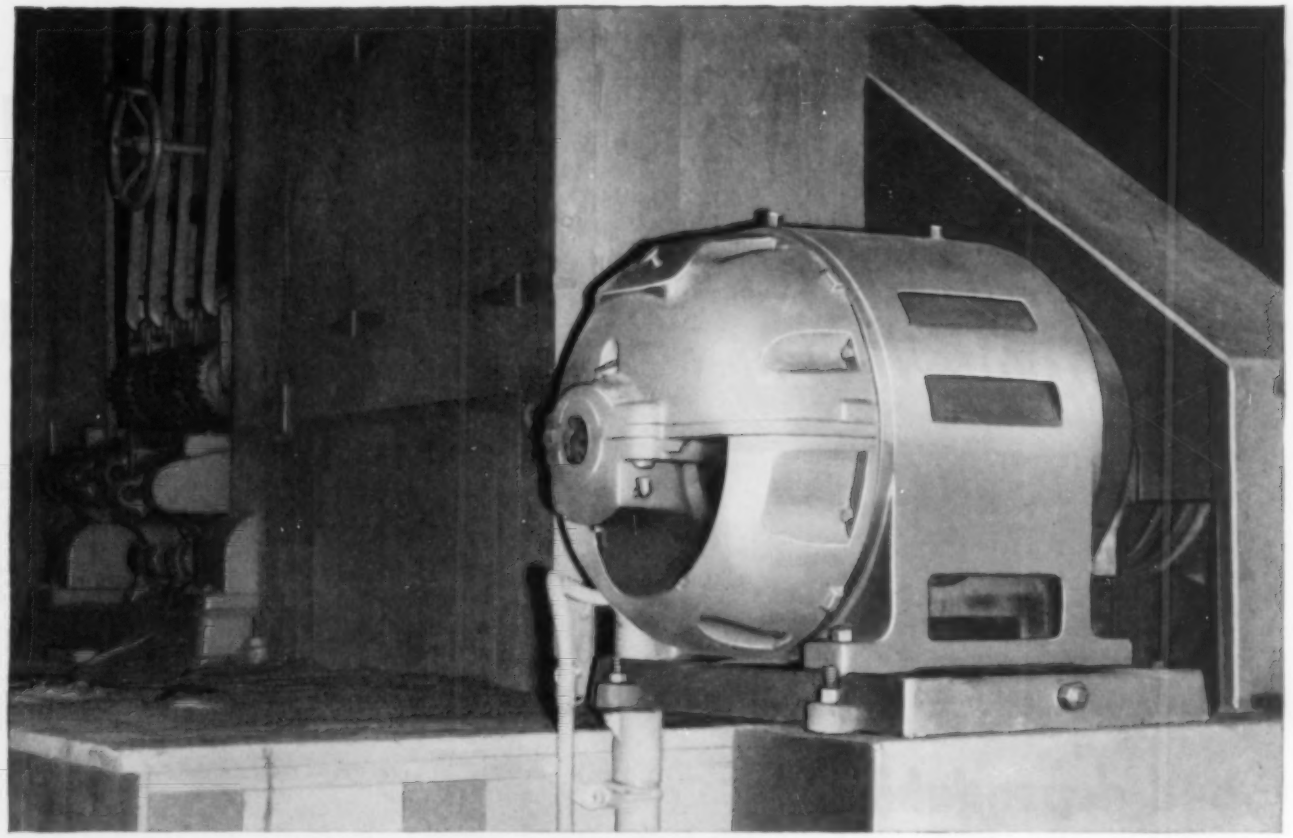


To meet the tough starting requirements of a ball mill, a mining company chose this G-E high-torque synchronous motor rated at 600 hp. Initial cost was low and the motor has given 20 years of dependable service.



Lower first cost of G-E synchronous motors is shown above. For applications in the white area, synchronous motors cost less than any other kind of motor. Calculations below show power savings on a typical 1000 hp, 514 rpm motor.

Gain in efficiency over other types of motors at same rating	**2.2%**
Hourly saving at power rate of $0.01 per/kwh	**$0.184**
Yearly saving (assuming constant operation)	**$1600.00**



Lower operating cost is the rule when General Electric Tri-Clad* synchronous motors are used with equipment such as this horizontal band re-saw, operating almost continuously at heavy loads.

Offer Double Savings

Lower First Costs, Lower Operating Costs Can Be Realized on Large, Constant-Speed Applications in Many Industries

Before you select a drive for a large equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. On many applications such as pumps, compressors, fans, etc., outstanding savings are available.

LOWER FIRST COSTS

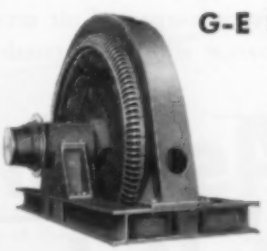
In most ratings where horsepower is equal to or greater than speed, the price tag on a synchronous motor with exciter and control is less than that of any other a-c motor with its control.

And, because a synchronous motor improves plant power factor, initial investment in distribution equipment frequently can be reduced. (The load which any new or expanded power system will carry is proportional to the plant's power factor.)

LOWER OPERATING COSTS

A synchronous motor usually has a higher full-load efficiency than any other type of motor, produces more work per dollar's worth of power consumed. Where loads are heavy and continuous, an advantage of from 0.5 to 3.0% in efficiency pays off.

Engineers with many years of field experience will tailor G-E synchronous motors and control to your job. Call in your General Electric representative—he'll be glad to discuss your particular application. And for more information on G-E synchronous motors, write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) to Section 770-26, *General Electric Company, Schenectady 5, N. Y.*



BE SURE TO SPECIFY G-E SYNCHRONOUS MOTORS

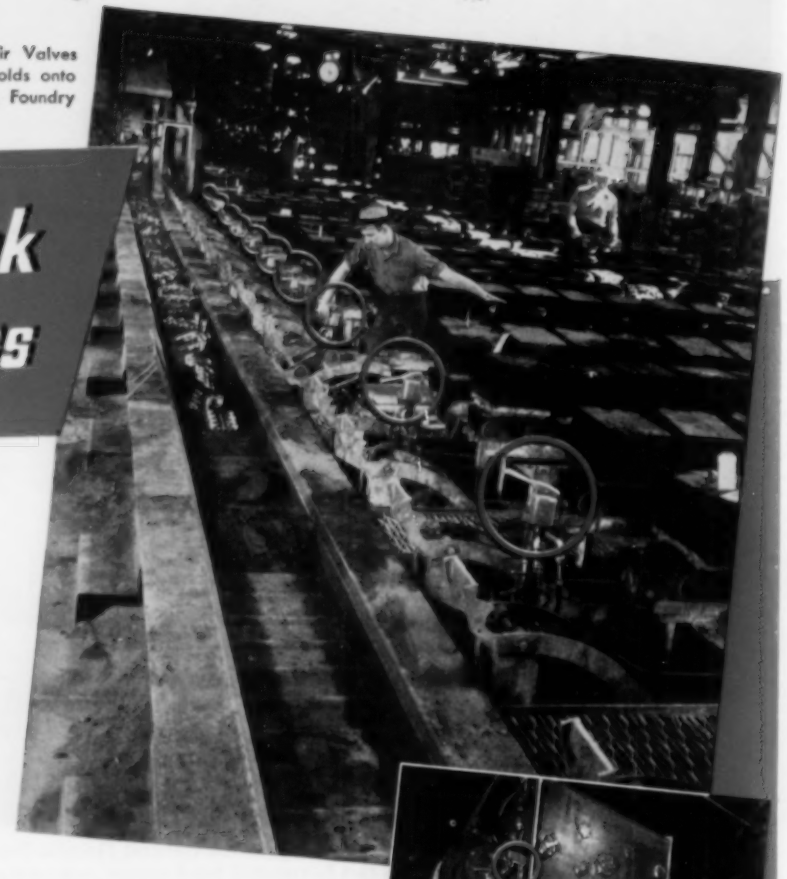
The result of more than 55 years experience in development, manufacture, and successful application, General Electric's line of synchronous motors is available in low speed and high speed types, engine-type and Tri-Clad* construction.

Numerous exclusive design and construction features promote long, dependable service. Get the full details!

**Reg. trademark U.S. Pat. Off.*

GENERAL ELECTRIC

770-26



Hand Operated Air Valves Dumping Poured Molds onto Apron Conveyor in Foundry

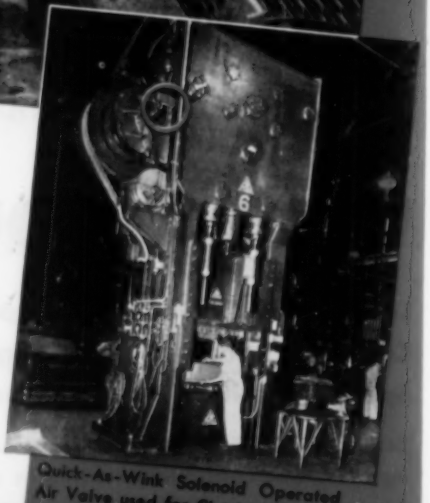
Quick-As-Wink Control Valves

un-paralleled performance and dependability

no after hours Siss-s-s-s

That low sizzling noise you hear out in the plant, after the work force has gone home, is there during the day too, only you can't hear it then. It's air. Seeping out through inferior valves it wastes from $5.00 to $500.00 per month — and — leaky valves mean sloppy machine control; danger of "repeating"; possible injury to the operator; or a break-down involving costly repairs, material spoilage, lost production and customer ill-will.

Stop that sizzling by installing Quick-As-Wink valves on your air and hydraulic controls. Positive and fast-acting Quick-As-Wink valves are designed and built with U-shaped packers that are expanded by pressure and seal tightly, preventing leaks, and minimizing the danger of break-downs and tie-ups. Recognized by operators, foremen and superintendents everywhere for unsurpassed air economy, high efficiency, low maintenance and long, trouble-free satisfactory performance.



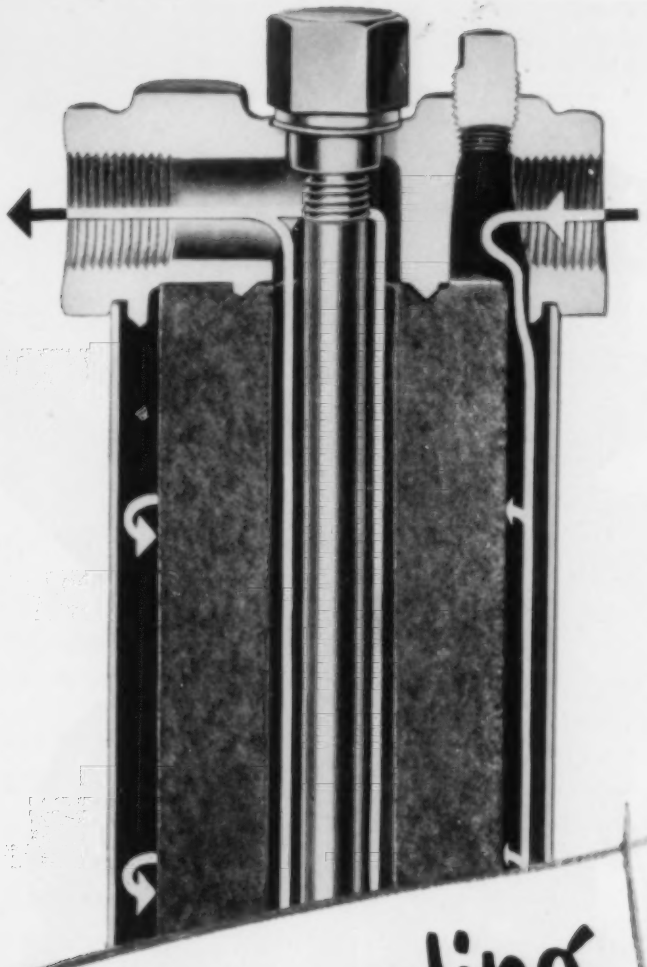
Quick-As-Wink Solenoid Operated Air Valve used for Clutch and Brake Control on Large Press

Air Valves used for Raising and Lowering Furnace Doors

Quick-As-Wink AIR AND HYDRAULIC Control Valves

Hand, Foot, Cam, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1911 East Pershing St., Salem, Ohio



No Channeling with this micronic filter

Won't shrink, won't swell. Won't harden, won't soften. Won't distort in any way. That's Cuno MICRO-KLEAN . . . the filter that outlasts any other replaceable-cartridge filter 2 to 1!

Get Dry, Clean Air the Positive Way

Entrained moisture and dirt in compressed air just don't *find* a way to get through a Cuno MICRO-KLEAN Air Line Filter.

As the cutaway shows, the air entering the filter first encounters a baffle (A) which deflects some moisture down outside the cartridge.

Then the air is forced into the porous fibre structure of the cartridge (B), being required to make many sharp turns through ever-narrowing passages, impinging eventually on the fibres.

The moisture promptly drains off these non-wicking fibres into the large collection chamber (C).

Fewer Cartridge Changes

There's more room for dirt in the MICRO-KLEAN cartridge . . . meaning you need to change it less often—*half* as often.

That's because its exclusive construction—"graded density in depth"—reduces surface loading and permits smaller particles to penetrate to varying depths.

Pressure drop across the cartridge is slight due to the openness of the structure—80-90% porosity—and to the absence of purely structural components (none needed) that offer resistance to flow.

Test Cuno MICRO-KLEAN Air Line Filters on your equipment—pneumatic tools, air-operated instruments, spray systems, etc.—and be *sure* of dry, clean air.

CUNO

Removes More Sizes of Solids from More Kinds of Fluids

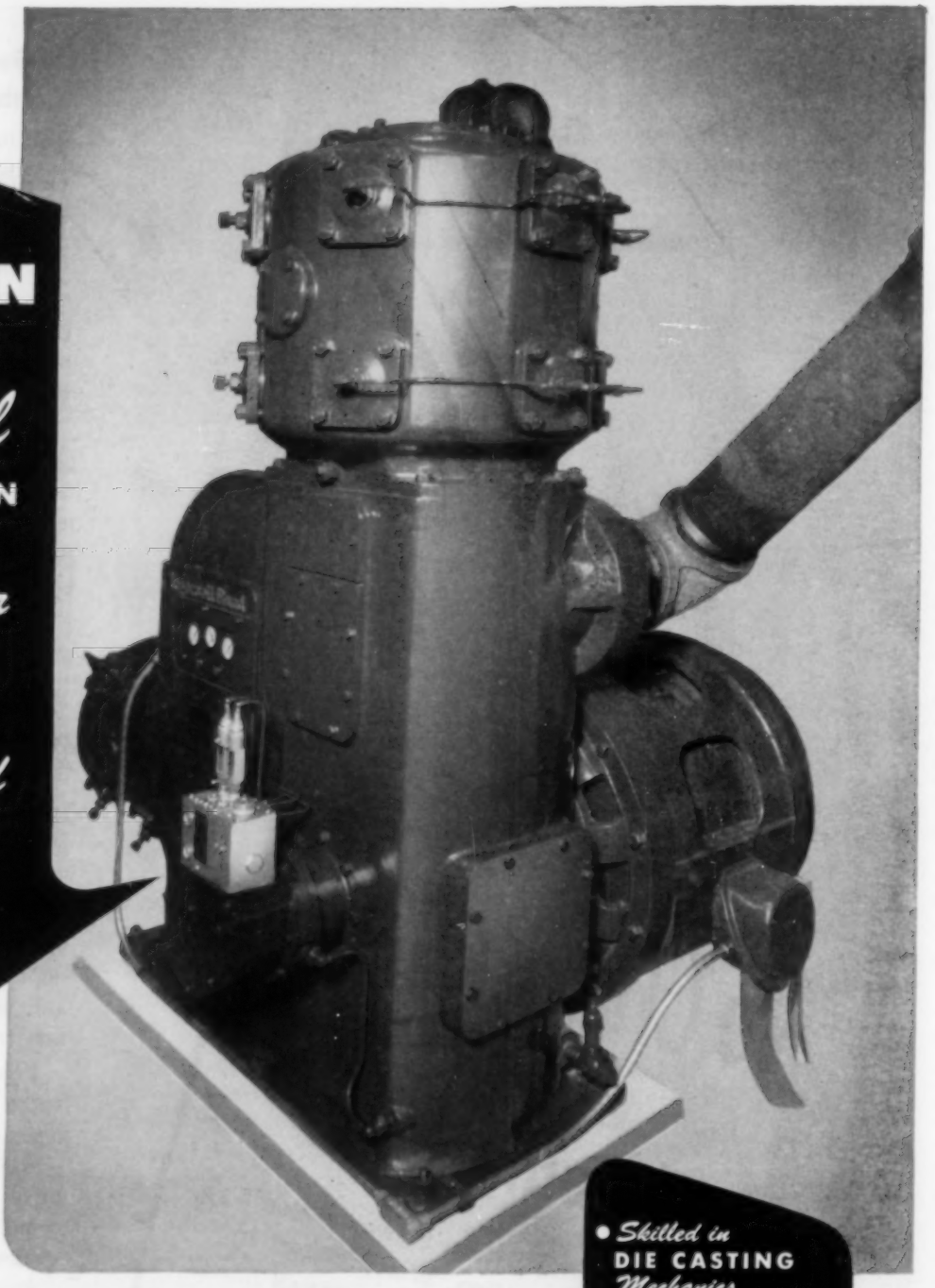
Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

Fluid Conditioning

Cuno Engineering Corporation
Dept. 178D South Vine Street, Meriden, Conn.
Please send information on Cuno MICRO-KLEAN
Air Line Filters for.....
(mention application)
Name.....Title.....
Company.....
Address.....
City.....Zone....State.....
Please attach to business letterhead

MADISON -KIPP *fresh oil* LUBRICATION

fed under pressure by the measured drop!



Illustrated, the Madison-Kipp Model SVH Lubricator on an Ingersoll-Rand XLE Compressor.

- *Skilled in* **DIE CASTING** *Mechanics*
- *Originators of Really High Speed* **AIR TOOLS**
- *Experienced in* **LUBRICATION** *Engineering*

....STANDARD EQUIPMENT ON COMPRESSORS, WORK ENGINES AND MACHINE TOOLS....

Oil under pressure fed drop by drop from a Madison-Kipp Lubricator will definitely increase the production potential for years to come when applied as original equipment on new machine tools, work engines and compressors. There are six popular models for every application. Write for special engineering data for your particular requirement.

MADISON-KIPP CORPORATION

202 WAUBESA STREET, MADISON 10, WIS., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

WITH HANSEN COUPLINGS

minutes SAVED are hours GAINED

QUICK-CONNECTIVE COUPLINGS FOR

- AIR
- OIL
- GREASE
- WATER
- VACUUM
- STEAM
- OXYGEN
- ACETYLENE
- GASOLINE
- COOLANTS
- REFRIGERANTS
- HYDRAULIC FLUIDS

CONNECTION TAKES ONLY A SECOND

You save time with Hansen couplings every time you connect or disconnect a fluid line carrying gas, liquid or grease, because Hansen couplings connect or disconnect immediately—with instant automatic flow or shut-off.

To connect, merely push plug into socket—flow starts instantly. To disconnect, pull back sleeve on socket—coupling disconnects and automatically shuts off flow.

From a wide range of available sizes and types, you can select a Hansen coupling—one-way shut-off, two-way shut-off, or straight through type—each engineered for your specific application.

If you have any fluid lines in your plant, you can increase efficiency, save precious minutes, by the use of Hansen Couplings.

Representatives

BALTIMORE	HARTFORD
CHICAGO	LOS ANGELES
CLEVELAND	MILWAUKEE
DALLAS	MINNEAPOLIS
DAYTON	NASHVILLE
DENVER	SAN FRANCISCO
DETROIT	SEATTLE
FT. WAYNE	ST. LOUIS

MONTREAL • TORONTO

Export Department: CLEVELAND

Write for Catalog

giving descriptions and sizes of complete Hansen line of straight through and shut-off couplings for hydraulic and pneumatic connections.

QUICK CONNECTIVE FLUID LINE COUPLINGS . . .

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

Quality Clutches Exclusively

The policy of Industrial Clutch Corporation since its inception 21 years ago has constantly been to design and build only the best clutches that engineering experience and a skilled group of workmen could produce, and to price such clutches as low as was consistent with high quality. We have steadily refused to sacrifice quality for the sake of a low price and, therefore, our product and services appeal primarily to those discriminating clutch users who appreciate superior quality.

Our modern plant is directed by clutch engineers and equipped with a full complement of precision machine tools, jigs and fixtures for producing clutches of the highest quality in any required quantity. We have a standard line of Flex-Disc Clutches, in both spring loaded and over-center types, ranging in sizes from 8″ to 35″ diameter—also air operated "Flex-Disc" clutches in a complete range of sizes for punch press and similar applications. Special clutches are designed and built for operating requirements that can not be met by commercially available mass production clutches.

Inquiries for either "standard" or special types of clutches will receive prompt attention. Our engineering service on clutch problems is available without obligation.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin

Eimco's - - - for hard rock loading

"Yes! When the job is tough you need an Eimco." Tunnel men, contractors or miners agree there is no argument about the loading equipment on their job.

This preference for a piece of equipment on the job had to be established by the equipment itself. That's why Eimcos are all made of the finest in heat-treated, alloy-steel castings and every piece of these machines is thoroughly tested and inspected before it goes to the assembly floor.

Eimco knows hard rock conditions; their engineers know what is demanded of these machines and as a result you get a piece of equipment on which you can depend for speed and economy.

There is an Eimco for every underground rock loading job. Write for information.

EIMCO

A365

You Can't beat an Eimco

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES – SALT LAKE CITY 10, UTAH, U. S. A.

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KELLOGG, IDAHO, 307 DIVISION ST. • LONDON W. 1, ENGLAND, 190 PICCADILLY

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
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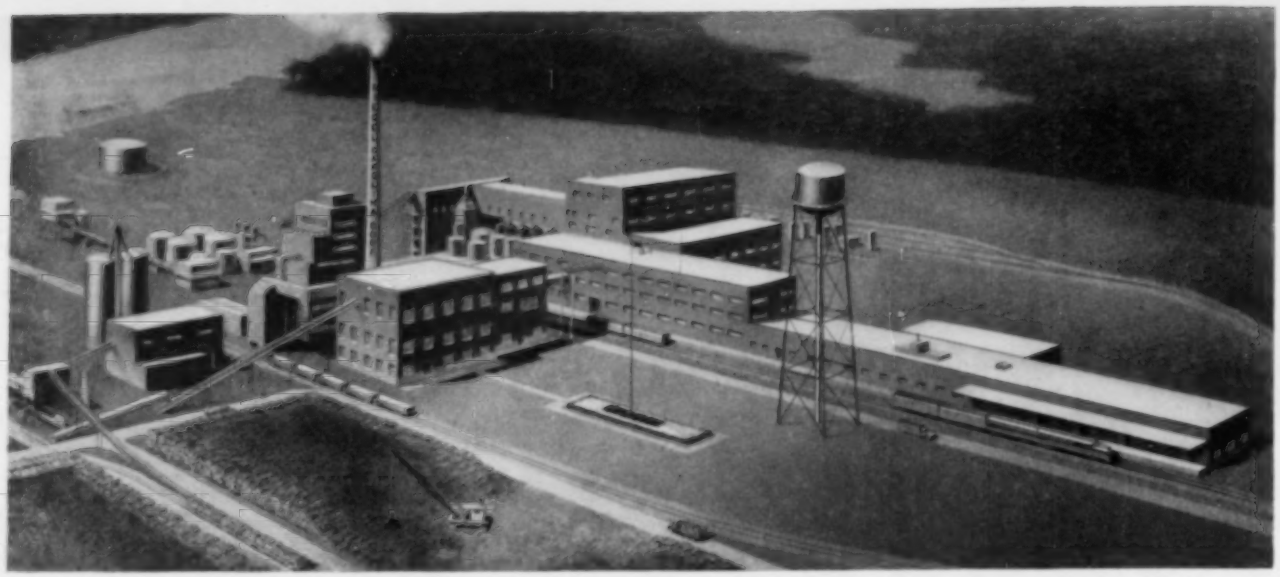
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD



71 Ingersoll-Rand Pumps installed at

Riegel-Carolina's New Pulp Mill

Ranging in size from ¾ to 400 hp, they serve throughout plant

Riegel-Carolina Corporation's new 20 million dollar bleached kraft specialty pulp mill at Acme, N. C. is being rushed to completion and is scheduled for full-scale operation early this year. The 45-acre site will produce 200 tons of bleached sulphate pulp daily from pulpwood grown on the company's holdings in the nearby Waccamaw forest. Modern in every detail, this new mill takes advantage of all the recent economies developed in the production of bleached kraft pulp.

Ingersoll-Rand pumps serve in practically every phase of the pulp producing process, handling stock of varying consistencies, black liquor, bleach chemicals and general service water. They range in size from Motorpumps of ¾ horsepower to 400 horsepower boiler feed units. The latter are ultra-modern Class HMTA 6-stage pumps, designed with a Unit-Type rotor assembly for sustained high efficiency and easy maintenance.

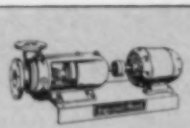
Modern pulp and paper mills can find the best solution to their varied pumping problems in Ingersoll-Rand's complete pump line. An experienced field engineer will be glad to study your problems and make his recommendations for efficient, dependable pumps to suit your particular process.

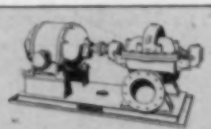
Ingersoll-Rand

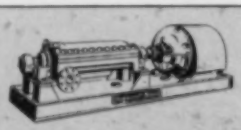
Cameron Pump Division 740-10
11 Broadway, New York 4, N. Y.

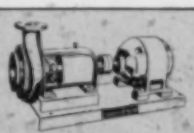
PUMPS • CONDENSERS • COMPRESSORS • DIESEL ENGINES
VACUUM EQUIPMENT • AIR AND ELECTRIC TOOLS

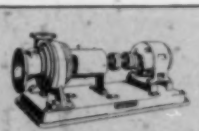
Here are a few of the pumps installed and their services:


CORVL, Black liquor


AFV, White water


HMTA, Boiler feed


MCS, Bleach liquor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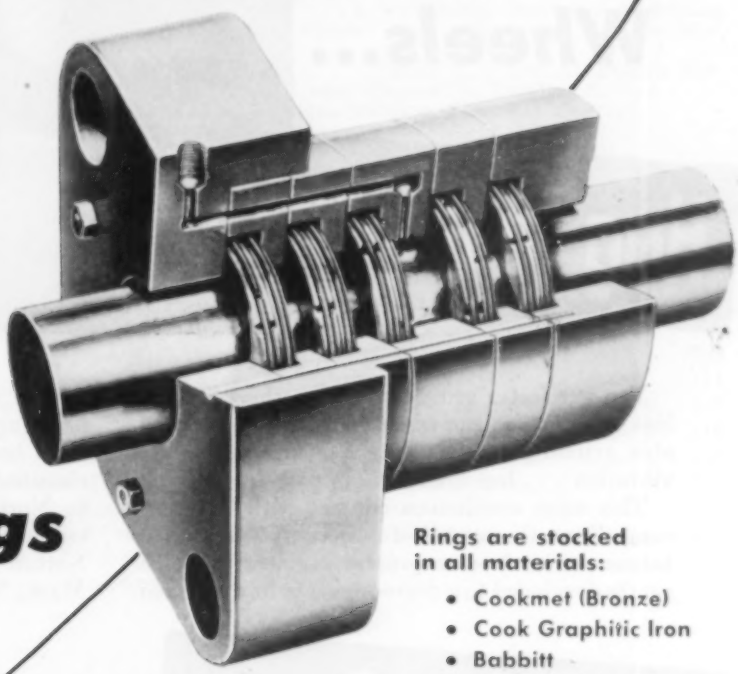

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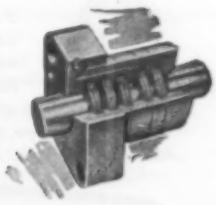

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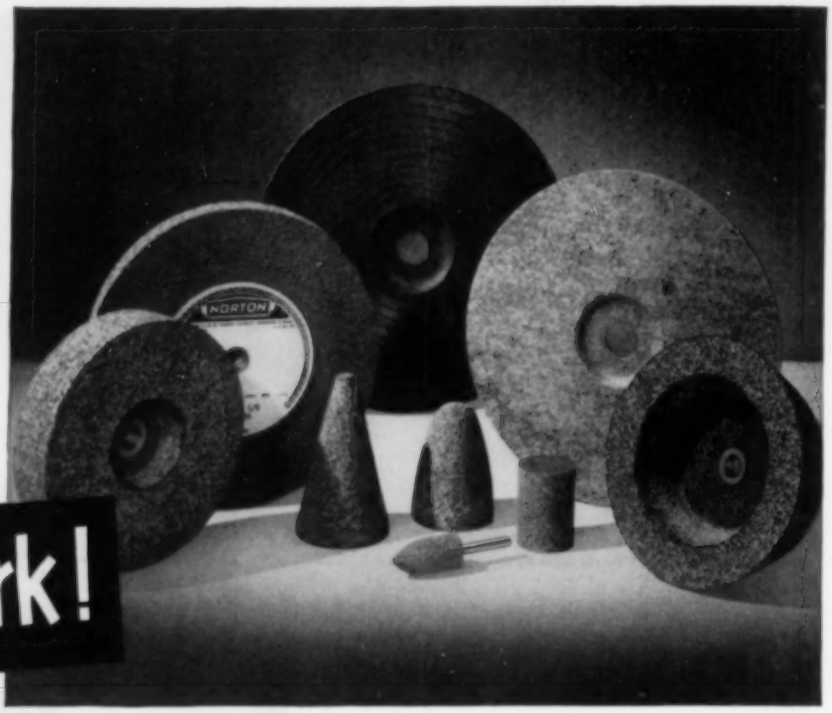

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ON THE COVER

THE giant metal-peeling machine, technically described as a 40-foot, open-throat planer, is used by Wyatt Metal & Boiler Works, Houston, Tex., mainly for beveling steel plate prior to welding. The operator rides a carriage that has a top speed of 45 feet per minute. When set to trim to a depth of ⅛ inch, and with the carriage traveling at 15 feet a minute. The machine can remove 34 cubic inches each minute from a 1½-inch plate of mild steel. When supplied with compressed air at 90 psi pressure, the 27 jacking cylinders can exert a clamping pressure of 270,000 pounds. They are arranged in six banks of four units each, and one of three units, or any combination of groups, can be operated to hold plates of varying sizes. The machine, which has an over-all length of 63 feet, was built by Baldwin-Lima-Hamilton Corporation.

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IN THIS ISSUE

PARADOXICALLY, compressed air, which feeds most fires, starves oil blazes. Socony-Vacuum Oil Company's experiments may reduce future losses in the petroleum industry. Page 94.

•

RESEARCH in low-temperature physics has heretofore been hampered because laboratories have had to build their own expensive gas-liquefaction apparatus to produce the cold required. Now there is a self-contained refrigerator, the Collins helium cryostat, that reaches down within a fraction of a degree of absolute zero, minus 459°F. Page 98.

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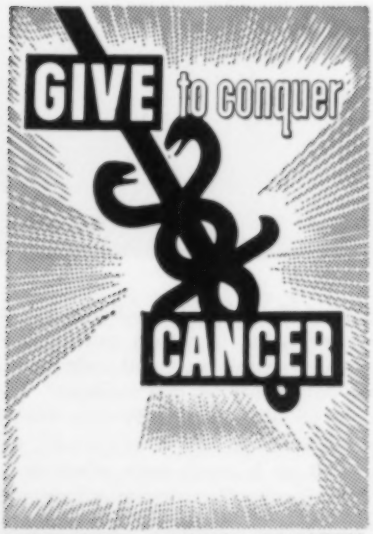
IN OHIO a contractor won a race against time. Thanks to the speed made possible by air-operated tools, bridge-pier repairs were completed a few hours before the Muskingum River rose sharply. Page 108.



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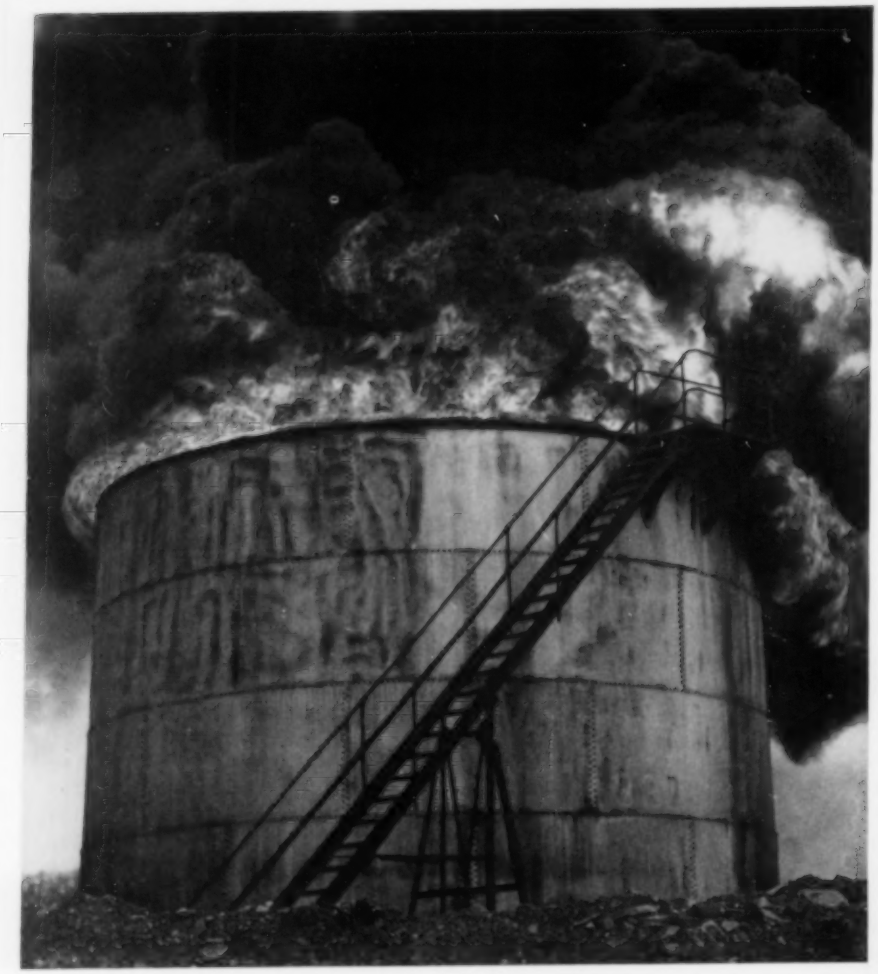
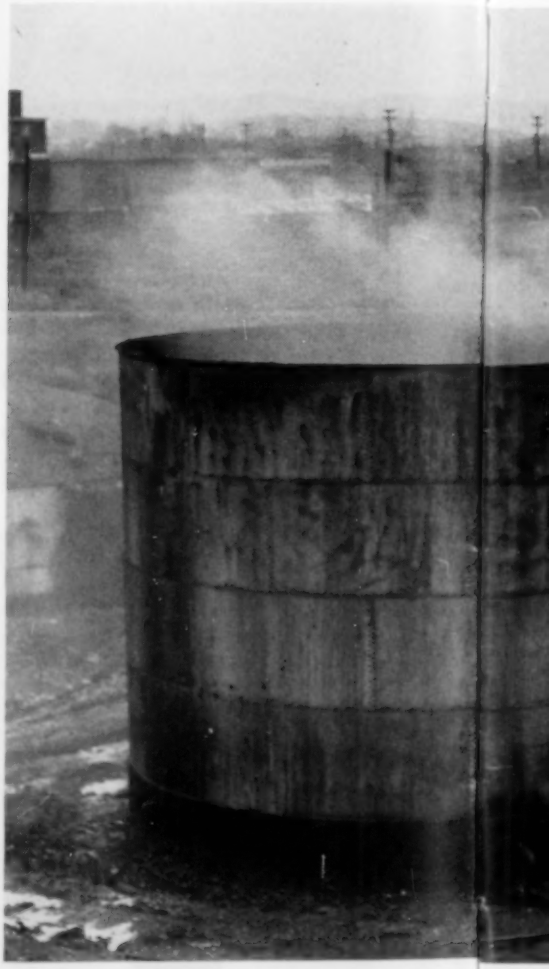


Air Tames Unruly Oil Fires

Remarkable Effect of Agitation Shown by Socony-Vacuum Oil Company Tests

C. H. Vivian



OIL fires, which are generally feared and considered among the most difficult of all blazes to combat, can be conquered in a matter of seconds or minutes merely by agitating the burning liquid with compressed air. That is the conclusion drawn from tests conducted recently by Socony-Vacuum Oil Company, Inc.

This simple method will not quench all oil fires. For it to be successful the oil must, first, be confined in a tank or other container that will make it possible to stir the whole mass and, second, have a flash (ignition) point higher than the temperature of the atmosphere. But even when the latter condition is not met, agitation will subdue a blaze to the point where it can be readily extinguished by conventional means.

Compressed air as a means of fighting fire is therefore applicable to most tank farms and other storage facilities maintained by oil companies and also to similar installations in industrial plants that use large quantities of fuel oil or other liquid hydrocarbons. Of even greater importance, it can perhaps be used to protect oil tankers and barges by installing the necessary piping and a small compressor at moderate cost.

To understand why agitation quells or controls such a fire, assume that a tank of kerosene is ablaze. It is not the oil that burns but, rather, the vapor given off by it. In burning, the vapor heats a thin layer of the underlying liquid, and that creates more vapor to feed the flames. By introducing air beneath the surface, some of the cooler oil from a lower level is brought up by the well-known air-lift principle. Because its temperature is below the flash point of kerosene, the supply of vapor to the combustion zone is shut off and the fire is soon starved out. If the top layer of oil were allowed to remain undisturbed during the short time it takes to heat it to the flash point, the blaze would continue. However, the turbulence produced by the rising air changes the surface oil so often that it cannot do so.

The theory behind these developments is not new, but until of late little was done to put it into practice. It has long been known, for instance, that the cooling effect of oil can be used to quench fires. In demonstrations during World War II, small incendiary bombs were ignited and then extinguished by submerging them in kerosene. It was also noted that the severity of a blaze is reduced when the oil is violently agitated by circulating it with a pump, and it is even possible in small-scale tests to put out flames in this manner. However, no one would advocate treating an oil fire with oil; in any event, compressed air is much more effective.

The Socony-Vacuum experiments were begun last November at the company's Olean, N. Y., refinery and, so far as

is known, were the first in America to be conducted on such a large scale. They dealt with hydrocarbon liquids of two kinds, and the objective was different in each case. In the first series, a tank of 100,000 gallons of flaming kerosene was extinguished several times, the compressed air being introduced in a different way each time. Although only kerosene was involved, the results would have been the same, it is contended, had the fluid been fuel oil, linseed oil, or any other oil that does not volatilize at atmospheric temperature.

The second series had to do with crude oil, which is not in the same category as those just mentioned. It usually contains some gasoline, which vaporizes at atmospheric temperature and, consequently, cannot be put out by agitation, at least not until all its low-flash-point fractions have burned. But the tests proved that the flames can be reduced sufficiently so that they can be easily extinguished with foam. It was also demonstrated that the injection of air will prevent boiling over of the oil, known as slop-over, which makes it hard to cope with crude-oil fires.

Slop-over is caused by steam. Petroleum as it comes from the wells often contains some moisture. When the oil is stored, the water, being heavier, sinks to the bottom. If a fire occurs and burns for a considerable period, a heat wave is gradually transmitted downward, eventually reaching the water and converting some of it into steam. Because crude oil is rather viscous, the steam cannot readily rise through it, so it expands and pushes some of the oil over the top of the tank. If this water could be steamed out through the oil by agitation before it reaches the boil-over temperature, slop-over could be prevented.

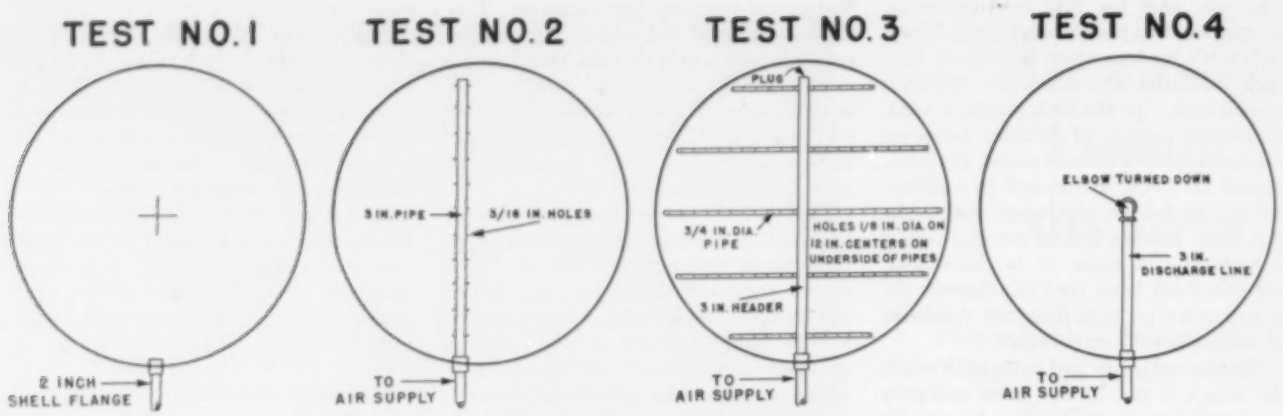
A noteworthy feature of the air-agitation technique is that it requires the addition of little special equipment insofar as tanks are concerned. The air can be pumped through lines with which they are normally provided for such purposes as drawing off water, steaming the bottoms to clean them, etc. The pipes are arranged so that any one line can be chosen to liberate the air either along the edge, at the center or at one or other of numerous points on the bottom. All that is necessary is to connect a compressor to a line leading to the tanks. Refineries and most other industrial establishments where there is tank storage have a central source of compressed air, and many of the larger ones also station portable compressors near the tanks to supply air for operating pneumatic tools and paint-spray guns employed in keeping them in repair.

The kerosene used in the experiments had a flash point of 126°F and filled a 30x30-foot cylindrical tank to a depth of about 18 feet, or to within 7 feet of the top. One-inch air lines were attached to the larger lines of the tank system at a point about 140 feet from the test tank. The air was admitted through a 1-inch valve, and means were provided to record consumption and pressure. Although the pressure at the gauge was 6 to 10 psi, it was calculated that the back pressure of the oil was such that there would be little positive pressure at the release points.

Four tests were made, the main difference among them being the locations

SUDDEN DEATH OF A KEROSENE FIRE

The first picture shows a tank containing 100,000 gallons of kerosene after it had burned uncontrolled for 2½ minutes. Five seconds after compressed air was introduced, the fire was out (second picture). Only 6¼ cubic feet of air at 6 psi pressure was needed. Two minutes later observers climbed to the edge of the tank to look inside (third picture).



HOW AIR WAS INTRODUCED

The sketches show the arrangement of the piping that was used to liberate compressed air in each of four tests. In all cases the pipes were located near the tank bottom. Storage tanks at refineries or other plants that handle petroleum or its derivatives in large quantities are normally equipped with piping as illustrated.

of the air-admission points. In all cases the fire was permitted to burn unimpeded for from 1½ to 2½ minutes so that it could get a good start. Then compressed air was introduced. Thirty seconds was arbitrarily taken as the time it would take the air to travel the 140 feet to the tank, allowance being made for the fact that it had to clear the line of liquid as it advanced.

In the first test, air entered the tank through a pipe connection at the bottom edge normally used for drawing off water. The blaze was extinguished in 30 seconds. The air rose vertically and created a swell or bulge on the surface close to the tank shell. From that area the cool subsurface kerosene that was being lifted up flowed across the tank to the opposite side. By the time the turbulence had spread over the whole surface, the fire was out. As air was being forced in at the rate of 50 cfm, it was evident that only about 25 cfm was used.

In the second test, air was released through ⅛-inch holes spaced 2 feet apart in a 2-inch pipe extending centrally across the tank bottom for a distance of 30 feet. It was figured beforehand that the turbulence that would be required to extinguish the flames could be created by injecting air at 10 psi pressure at the rate of 55 cfm. Actually the fire was out in 35 seconds, so only about 30 cubic feet of air was needed. The indications were that the fire had ceased burning by the time air was beginning to issue from the last of the perforations.

In test No. 3, the air was introduced by aid of a spider that had been placed in the tank to serve as a steaming device. In the form of latticework, it consisted of five paralleling, equidistant crosspieces of ¾-inch pipe connected centrally to a 3-inch supply line running perpendicular to them. Each transverse pipe was perforated with ⅛-inch holes spaced 12 inches apart. When air was admitted at 6½ psi pressure and at the rate of 40 cfm, the fire was snuffed out in twenty seconds. Air consumption amounted to 14 cubic feet, and it was obvious that extinguishment occurred before all sections of the spider had been cleared of kerosene by the advancing air.

In the fourth test, air was introduced through a 3-inch line terminating in an elbow turned down at the center of the tank bottom. The normal function of the line is to withdraw the stored product. In this instance, the result, according to the report, was "unbelievable," but it was certified by several engineers who served as timers. Five seconds after the air reached the tank the blaze was out!

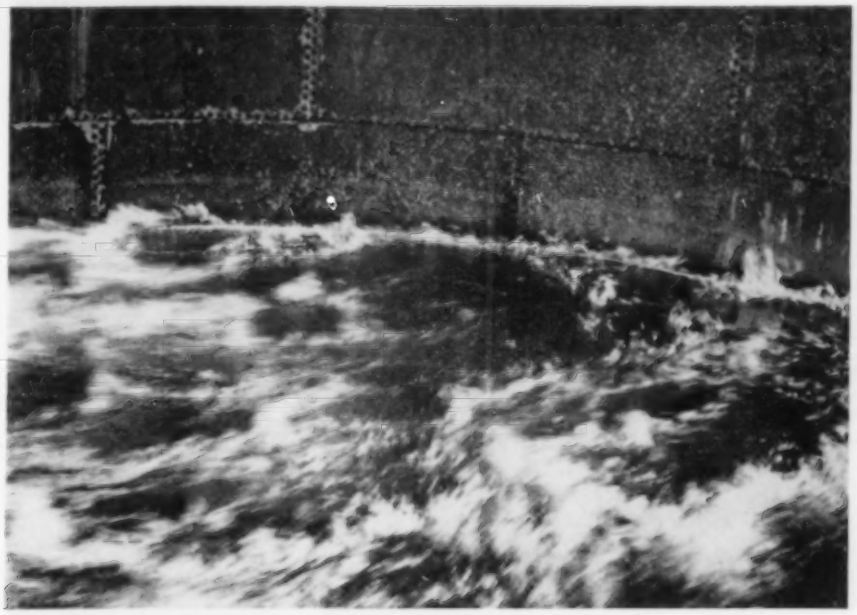
Air was admitted at the rate of 75 cfm and at 6 psi pressure, actual air consumption being computed at 6¼ cubic feet. The quick action obtained was attributed to the fact that the air formed a bulge of oil in the middle of the tank from which cool oil flowed in all directions to the perimeter. The maximum distance of travel was 15 feet. In consequence, it was concluded that most effective agitation is obtained by introducing the air at the center. In this connection it became evident that if central injection were applied to a tank 80 feet in diameter the turbulence would have to travel a maximum distance of 40 feet, only 10 feet farther than in the first test, in which the flames were quenched in 30 seconds.

In the second series of experiments, 100,000 gallons of crude oil was ignited in the 30x30-foot tank that had been used previously, and the piping was the same as before. Again, several tests were made under varying air-injection conditions, duplicating the earlier ones except that air was at no time admitted at the center of the tank. The air pressure was kept within the same range as before, but the volume introduced was higher: from 22 to 90 cfm.

In all cases the air immediately reduced the flames, so much so in fact that, after the stairway on the side of the tank had been cooled with water from a hose, observers mounted the platform overlooking the interior to inspect conditions and take photographs. Some even leaned over the rail and looked straight down on the fire, which rose from the oil's surface 7 feet below the top of the tank. Attempts were made to quench the blaze with two 30-pound dry-

SLOP-OVER

When moisture is present in burning oil, which is often the case with crude, it ordinarily goes to the bottom because of its greater weight. Slop-over occurs if a heat wave travels downward from the surface to the water zone and creates steam. Because the oil is viscous, the steam has difficulty in passing through it and frequently expands, pushing some of the liquid over the side of the tank. In the demonstration illustrated, a 55-gallon tank was used.



SUBDUED CRUDE-OIL FIRE

Although some of the more volatile fractions that vaporize at atmospheric temperature were still burning, the turbulence set up by the churning air had reduced the flames to a height of about 12 inches when this picture was taken. Such a fire can be extinguished readily with foam.

chemical extinguishers, but without success.

Finally, after two hours, during which the fire was alternately kept burning freely and under the control of air agitation, a representative of the National Foam Company climbed the stairway and used a 1½-inch mechanical nozzle to put the blaze out with foam. He applied only two pails of the liquid, which spread over the surface of the oil and smothered the flames in five minutes. The foam lay smoothly and showed no tendency to expand or boil over, although in demonstrations prior to the test, with crude oil in 55-gallon containers and without air agitation, it was found that even after a fire was extinguished by placing a cover on the container there was an immediate and violent slop-over reaction when foam was added.

By using heat-detecting paint on the tank walls, the rate of travel of the heat wave was observed. It was known from previous experiments that a wave moves about 48 inches an hour in unagitated oil, which, in the last-mentioned case, would have meant a travel of 100 inches in the time that elapsed between ignition and extinguishment. The paint revealed, however, that there was no downward movement of the heat during agitation, and only about ½ inch during the period of preburning when the air was shut off. At the conclusion of the experiments the temperature of the crude was the same throughout, having risen from 50° to 83°F during the 2-hour burn.

An interesting side light that has a bearing on the crude-oil tests is found in a report written 24 years ago. Apparently, the fact that air is an effective means of preventing slop-over was discovered accidentally. When lightning struck near a Socony-Vacuum wooden-roofed 70,000-barrel tank of crude oil in 1928, efforts to extinguish the resultant fire with the small quantity of foam powder that was available were unsuccessful. To save as much of the oil as possible, steps were taken to withdraw it through a line extending from the bottom of the tank. When the pipe became plugged, compressed air was turned in to clear it. A distinct lessening of the flames' intensity was noticed, so the air was left on. In the meantime, arrangements had been made to ship in a carload of foam. When it arrived the next morning and everything was ready to apply it, the air was shut off. Immediately the oil boiled over the sides of the tank, destroying hundreds of feet of hose and causing everyone to flee from the danger zone.

Impressed by what had happened, L. B. Van Leuven, on the oil company's staff, obtained authority and funds to conduct some experiments. When these proved successful, he developed a spider arrangement of air piping for tank bottoms. Apparently, the purpose for which he designed this network was somewhat lost sight of. Curiously, the report came to light while preparations were being made for the Olean tests.

The experiments were initiated and directed by Joe L. Risinger, in charge of safety and fire protection for Socony-Vacuum. They were witnessed by more than 40 persons, including representatives of oil companies, firms that make fire-fighting equipment, and members of the Olean and Buffalo fire departments. It is the intention of the company to conduct further tests under varying conditions. Mr. Risinger has applied for a patent on the air-agitation system that will, if granted, be assigned to Socony-Vacuum. The latter has announced that it will permit anyone to use the method without payment of royalty.

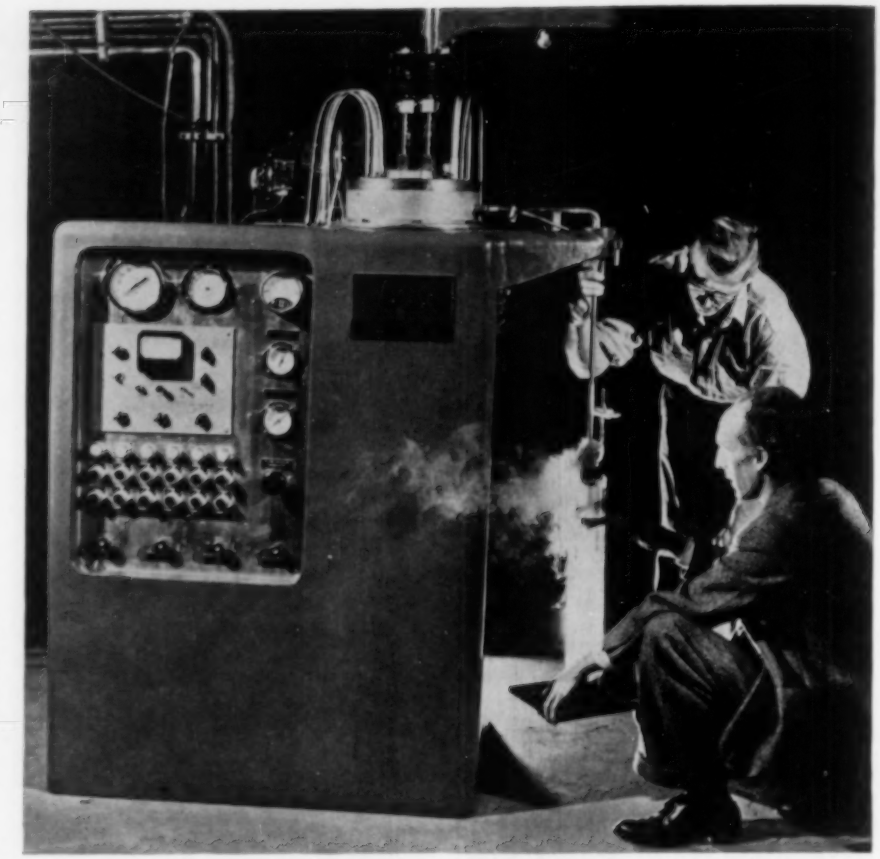
TESTING THE THEORY

Prior to the large-scale tests, the theory of extinguishment by means of agitation was proved by conducting a series of experiments with a pool of kerosene in an 8-foot-diameter earthen pit. This picture shows the liquid being stirred with a gooseneck fog nozzle.

Something New in Deep Freezers

Scientists Attain Temperatures Close to Absolute Zero with Collins Helium Cryostat

John Starr



DRAWING OFF LIQUID HELIUM

Liquefied helium can be drawn off through a tube that connects with a reservoir at the bottom of the dewar within the cabinet. The cryostat can produce 4 liters of liquid helium per hour if liquid nitrogen is used for precooling and only 2 liters if it is not used.

MATERIAL substances as we normally encounter them are characterized by the phenomenon known to physicists as "thermal chaos." In other words, each comprises a myriad of rapidly rotating particles such as electrons, whose motions constitute heat energy.

Take a piece of steel as an example: When at room temperature, it looks like the coldest and most motionless substance imaginable. But if you heat it enough you can increase its thermal chaos to such an extent that it will oxidize and become a different substance in a matter of seconds. On the other hand, if you put it in an ordinary refrigerator you can reduce thermal chaos so that the steel will not corrode for a comparatively long period, although it will eventually deteriorate.

In theory, if a substance is cooled to a temperature of absolute zero, which is equivalent to minus 459°F, thermal chaos can be halted so that no chemical changes will take place. But that's not as simple as it sounds. In fact, there is reason to believe that no substance can be cooled to absolute zero with available man-made equipment because the latter invariably necessitates some use of thermal energy.

However, laboratory scientists have developed several refrigerators capable of creating temperatures that approach absolute zero, and one that misses it by only a fraction of a degree. This super deep-freeze box, technically known as a helium cryostat, was invented by Dr. S. C. Collins of the Massachusetts Institute of Technology in conjunction with one of his former students, Dr. Howard O. McMahon. It is manufactured by Arthur D. Little, Inc., of Cambridge, Mass. Doctor McMahon of the ADL staff and Doctor Collins, a consultant, were recently honored by the Franklin Institute, Philadelphia, Pa., for their contributions to low-temperature physics.

The first research in the low-temperature field provided knowledge that paved the way for making artificial ice and later led to the household refrigerator, both highly important in improving our standard of living. However, the early investigators were not interested in producing cold but rather in finding out if all gases could be liquefied. They began by liquefying ammonia in 1798, and that work became the basis for the commercial refrigeration industry which blossomed in the latter part of the last century.

Dry ice, or solid carbon dioxide, which we are apt to think of as a recent development, was produced in 1835, although no practical use for it could then be found. One after another the gases yielded to laboratory workers, but for a long time they could not liquefy three of the commonest of them: oxygen, hydrogen and nitrogen.

In their efforts to liquefy the trio, investigators compressed them with all the equipment they had at hand, but squeeze as they would the gases remained adamant. Finally it was realized that no amount of pressure will liquefy a gas unless it is first cooled to its critical temperature, and the obstinate ones soon yielded. From then on no gas was able to resist, although helium was not liquefied until 1908.

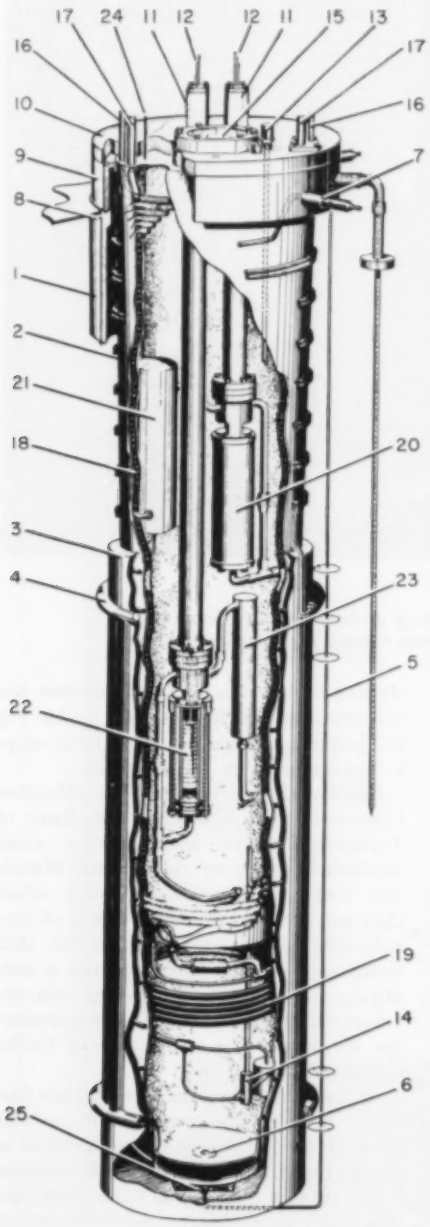
With so many gases to work with, and each one producing its own degree of cold, industry can fit the refrigerant to the particular cooling application at hand. For example: in the plant of the Consolidated Vultee Aircraft Corporation aluminum-alloy rivets are shrunk by chilling them with dry ice so that their shanks can be easily inserted into relatively small holes and then tightly wedged in them by expansion through room-temperature heat. Another application is found in the foundry of the Alloy Precision Casting Company. It consists in pouring liquid mercury into a mold at room temperature, freezing the metal within the mold, and using the casting as a pattern to form a cavity in a refractory material from which the mercury can be reclaimed at room temperature. It is fundamentally the same as the lost-wax or investment casting process (used in the manufacture of dentures and small metal parts), except that mercury patterns serve in place of wax patterns to make intricate mold cavities. The former are said to be superior because they retain their precise dimensions and

are 100 percent reclaimable (wax is normally lost after it has served to make one pattern for one cavity).

Helium serves as the refrigerant in the Collins helium cryostat because it is the only available gas that can attain a temperature in the neighborhood of absolute zero. Other gases also used as coolants in refrigerators liquefy at temperatures ranging from about 20 to 200° above zero on the Kelvin (absolute-temperature) scale. Helium liquefies at minus 452°F, only 7° above absolute zero, and still lower temperatures are being achieved by auxiliary means. At present, 0.0014°K seems to be the lowest yet reached by adiabatic demagnetization of paramagnetic salts. This process, formerly practiced only in great centers of cryogenic research, is now finding widespread application.

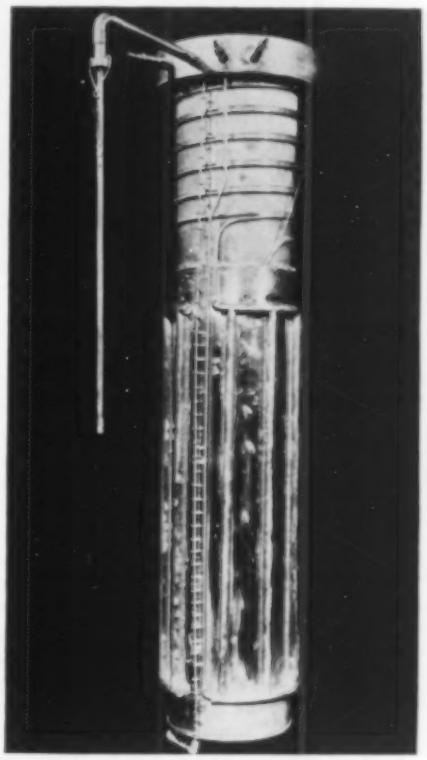
The purpose of the refrigerant in the Collins helium cryostat, or any mechanical refrigerator, is to cool other substances by absorbing their heat energy after the refrigerant has undergone compression. The thermodynamic properties of helium are such that liquefaction is more difficult in its case than in that of any other gas. Joule-Thompson expansion produces no refrigerative effect regardless of initial pressure until preliminary cooling to minus 253°C (minus 423°F) has been accomplished by some other means. In earlier liquefiers this was done by cascade systems using liquid nitrogen, liquid hydrogen, or both. Because these auxiliary refrigerants were required and entailed extensive additional apparatus, the liquefaction of helium was a cumbersome and costly operation. The Collins cycle depends upon expansion engines at two successive temperature levels, thereby eliminating auxiliary refrigerants.

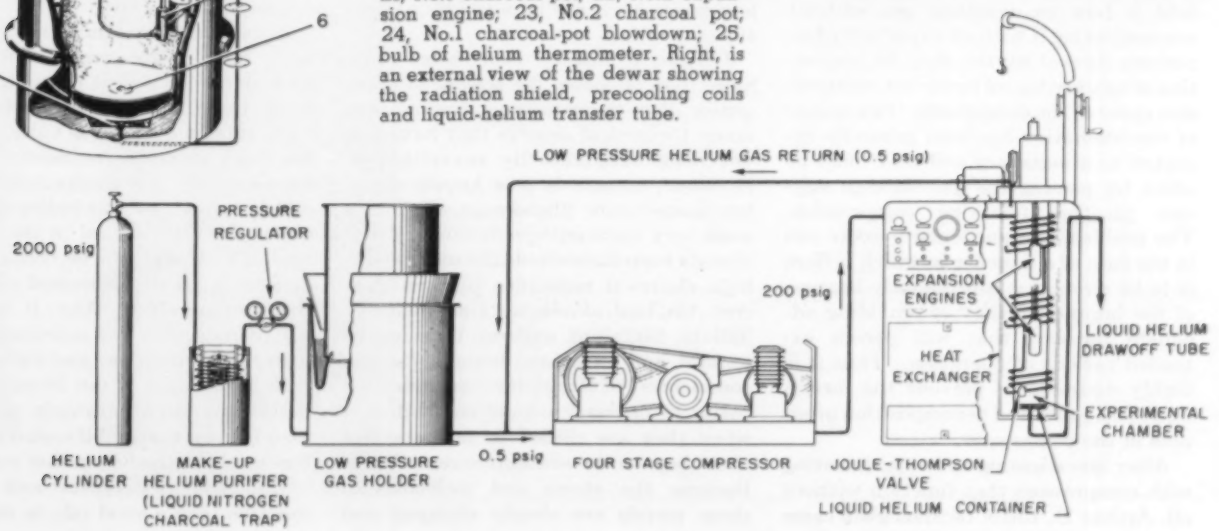
Reduced to its essentials, the process is one of compression, removal of the heat of compression by cooling with tap water, and thermal isolation of the cold end by gas-to-gas heat exchange. Temperature differentials at intermediate points in the heat-exchanger system

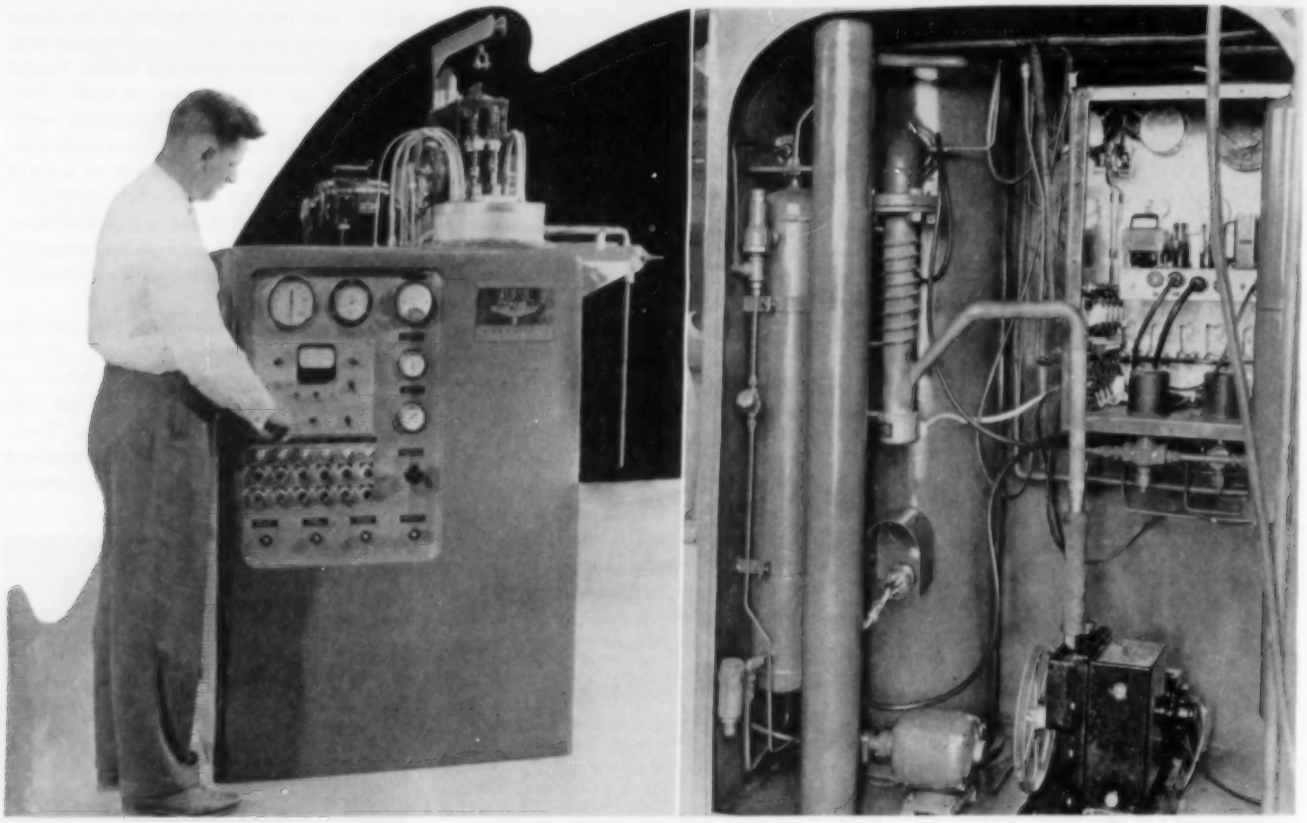


HOW IT WORKS

The Collins helium cryostat utilizes helium as the refrigerant. The main steps in reducing the gas to a liquid are: compression by a 4-stage compressor that discharges at 225 psi pressure, thermal isolation of the cold end by means of a gas-to-gas heat exchanger, expanding gas through engines at intermediate points in the heat-exchange system to produce temperature differentials, and liquefaction by adiabatic expansion through a needle valve. The heart of the cryostat is the dewar shown in cutaway fashion at the left. It contains the heat exchanger, expansion engines, and liquid-helium reservoir. Following is the key to the numbers: 1, Outer vacuum shell; 2, inner vacuum shell; 3, radiation shield; 4, auxiliary precooling coil; 5, liquid draw-off tube; 6, partition plug; 7, auxiliary liquefier inlet; 8, No. 1 flange; 9, No. 2 flange; 10, No. 3 flange; 11, stuffing boxes; 12, piston and valve rods; 13, J-T valve knob; 14, J-T valve body; 15, experimental-chamber opening; 16, compressed-helium inlet; 17, expanded-helium outlet; 18, main heat exchanger; 19, J-T heat exchanger; 20, No.1 expansion engine; 21, No.1 charcoal pot; 22, No.2 expansion engine; 23, No.2 charcoal pot; 24, No.1 charcoal-pot blowdown; 25, bulb of helium thermometer. Right, is an external view of the dewar showing the radiation shield, precooling coils and liquid-helium transfer tube.







CRYOSTAT CABINET

Front and rear views of the cabinet and control panel. The cabinet contains an experimental chamber that can be held at any temperature down to about minus 457°F by circulating liquid helium around it in a closed circuit.

are produced by isentropic expansion through engines; and, finally, liquefaction is effected at the cold end by isenthalpic expansion through a needle valve, where the temperature falls below the liquefaction point. Liquid helium is removed from the draw-off tube and put into an external dewar vessel—a simple operation. There is a return circuit within the cryostat that carries helium not liquefied, or helium that has evaporated, back to the first stage of the compressor.

One of the difficulties that has troubled all workers in the low-temperature field is how to compress gas without contaminating it with oil vapor or hydrocarbons formed by the slow decomposition of lubricating oil in the hot compression space of the compressor. This source of contamination has been generally accepted as a necessary evil that must be offset by passing the gas through suitable purifiers following compression. The problem is a particularly acute one in the case of a liquefier in which helium is to be circulated continuously because of the impracticability of providing adequate purifiers that will permit extended periods of operation. Thus it is highly desirable to prevent the formation of oil vapor and decomposition products in the compressor.

After investigating and experimenting with compressors that function without oil, Arthur D. Little technologists came to the conclusion that for their purpose they all had objectionable features which did not exist in the simpler types of oil-lubricated machines. This led them to try a common type of air compressor arranged for a two-to-one compression ratio so that compression temperatures would be low enough to avoid vaporization of certain of the special low vapor-pressure lubricants now available. Subsequent experience has proved that this combination of low-compression ratio and special low vapor-pressure oil avoids measurable contamination of the compressed gas by all except entrained droplets, which are easily removed by a filter-type separator.

Despite a history that dates back more than 50 years, the science of cryogenics (low-temperature physics) has many theoretical aspects that have not yet been satisfactorily investigated. However, enough is now known about low-temperature phenomena to justify some very optimistic predictions. It has already been discovered that metals with high electrical resistance such as mercury, tin, lead, aluminum, zinc, thallium, indium, tantalum, gallium, thorium, titanium and cadmium become "superconductors" of electricity—are much superior to ordinary copper conductors—when they are chilled to temperatures a few degrees above absolute zero. Why? Because the atoms and molecules of these metals are closely clumped and aligned by low temperatures so that the current does not lose energy by having to "jump" through relatively large empty spaces between the particles.

Similarly, investigators at Rutgers University and California Institute of Technology have learned that some substances such as columbium nitride can rectify alternating current when they are properly chilled. This is of considerable significance, but as yet that compound cannot be considered a substitute for selenium in making conventional rectifiers for electronic equipment for airplanes, sea-going vessels, tanks, communications, etc.

In many circumstances, materials that have been helium-cooled will resume their normal physical characteristics at room temperature. But not always. Some substances such as vulcanized rubber crack or are permanently damaged by extremely low temperatures, while other compositions, including the nylon-plastic fibers now used in the manufacture of clothing, can be cold-treated to give them greatly increased strength at room temperature. Also, it is interesting to note that the reactions of some materials to both low and high temperatures are similar, if not identical. Magnetized metals, for example, can be completely demagnetized if cooled and therefore used as screens against magnetism.

Collins helium cryostat and cryogenic research play a vital role in the current

development of atomic-energy for many reasons, no doubt, that have not yet been disclosed. However, it is a fairly well-known fact that hydrogen must be frozen if its particles are to be concentrated enough to be of effective use in making bombs. Furthermore, there seems to be a likelihood that helium-chilling will greatly increase the longevity of certain radioactive chemical elements produced by nuclear fission.

Most radioisotopes are extremely short-lived because their ruptured atoms rapidly disintegrate into basic energy particles or radiations. Radioactive zinc, for instance, can lose virtually all its energy in less than two hours. That is undesirable, because radioisotopes of all types could serve many practical purposes (in the treatment of cancer, the inspection of industrial products, etc.) if they could be transported from A-bomb plants at Oak Ridge, Tenn., and elsewhere to remote locations. However, that might not be economically feasible because of the difficulties involved in packaging liquid helium and radioisotopes in hermetic containers.

Current industrial interest in the helium cryostat is no doubt chiefly directed toward research in solid-state physics. It should be made clear, however, that other deep-freeze units on the market develop temperatures as low as minus 120°F and are adequate for testing metals, plastics, fabrics, ceramics and other materials for low-temperature application (the fabrication, for example, of parts for high-altitude aircraft and the manufacture of clothing to be worn by troops in Arctic regions), for the expansion fitting of metal parts and for other ordinary commercial cold-temperature work. Of them all, the Collins helium cryostat reaches the lowest temperature and is available for use where the others will not suffice. For the present, though, members of the Arthur D. Little organization classify it definitely as a research tool and state that it is becoming of great value as such. It provides liquid helium simply, whereas the earlier processes involve many difficulties and rather high pressures.

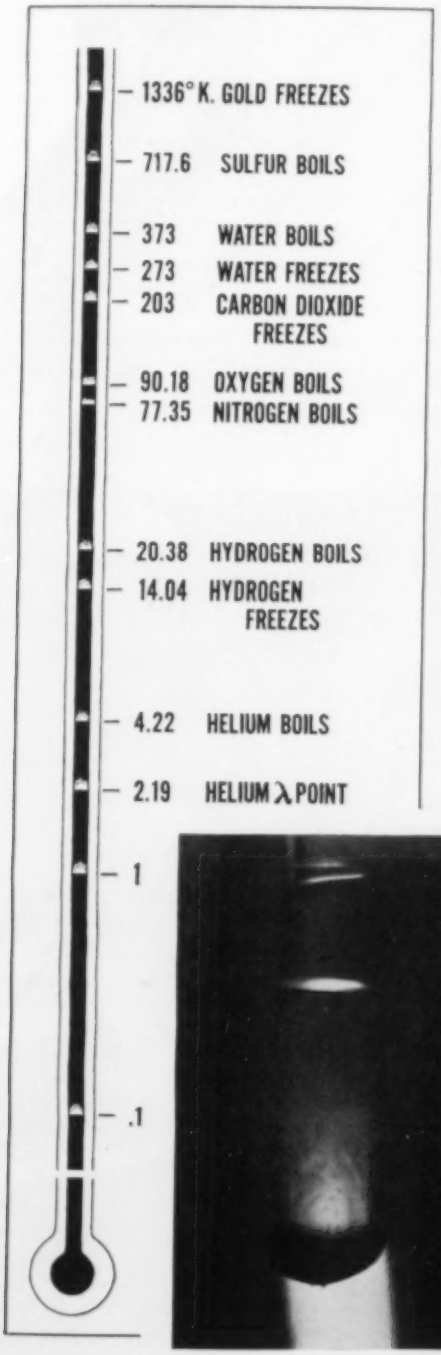
Scientists have been particularly impressed by the low-temperature behavior of liquid helium which causes it to creep over the sides of a test tube or retainer, as well as by its power to conduct heat. Practical uses for these characteristics may not be found for another hundred years, but it is generally believed that the study of low-temperature helium will eventually explain many mysteries of the universe.

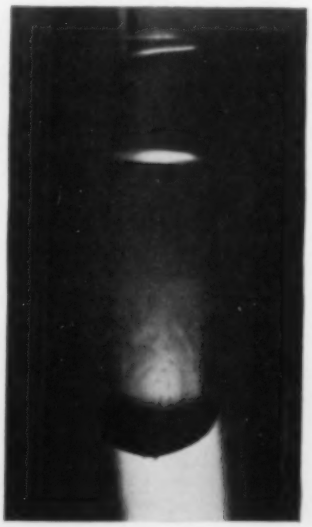
The first Collins helium cryostat was turned out in 1947, and since then 43 units of that type have been put in service, nearly all in college or industrial research laboratories. As an indication of the kind of investigations being conducted by their aid, M.I.T. reports that it is looking into the electrical resistance of cold-worked copper, the use of commercial phosphor-bronze wire in resistance thermometers at liquid-helium temperatures, and the viscosity of liquid helium under pressure. During 1950 the school's two cryostats made 92 "runs" totaling 543 hours and produced 1262 liters (1333.5 quarts) of liquefied helium for 345 individual experiments.

To sum up: The Collins helium cryostat is a specialized tool in the field of low-temperature technology. By making liquid helium available, it has enabled laboratories to study cryogenic research in a relatively simple way and has led to a better basic understanding of metals, crystals, liquids and gases and of electrical resistance and induction. New knowledge is gained daily through cryogenics . . . a research frontier that will almost certainly be of greater practical importance in the near future.

LOW-TEMPERATURE SCALE

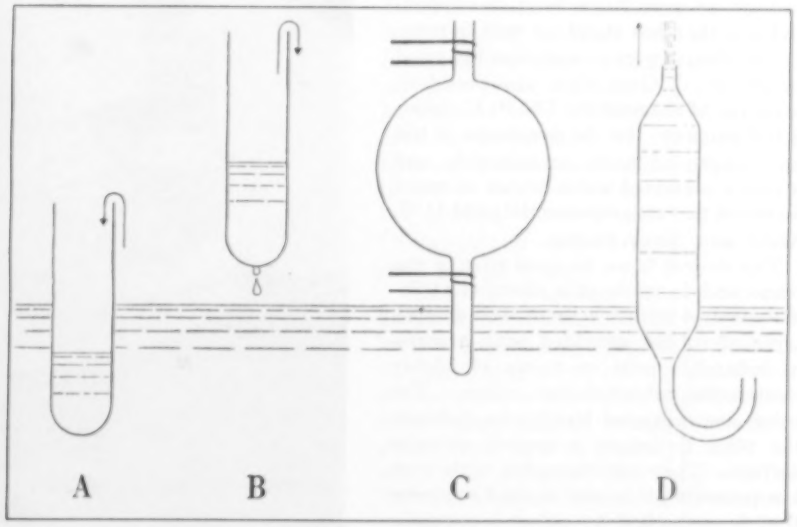
Hypothetical thermometer of significant temperatures in physics plotted by logarithmic scale to show the detail of the region close to absolute zero. The lowest notation for helium designates the "lambda" point at which the normally gaseous element becomes a semisolid or semiliquid, a condition described by physicists as a "fourth state of matter."



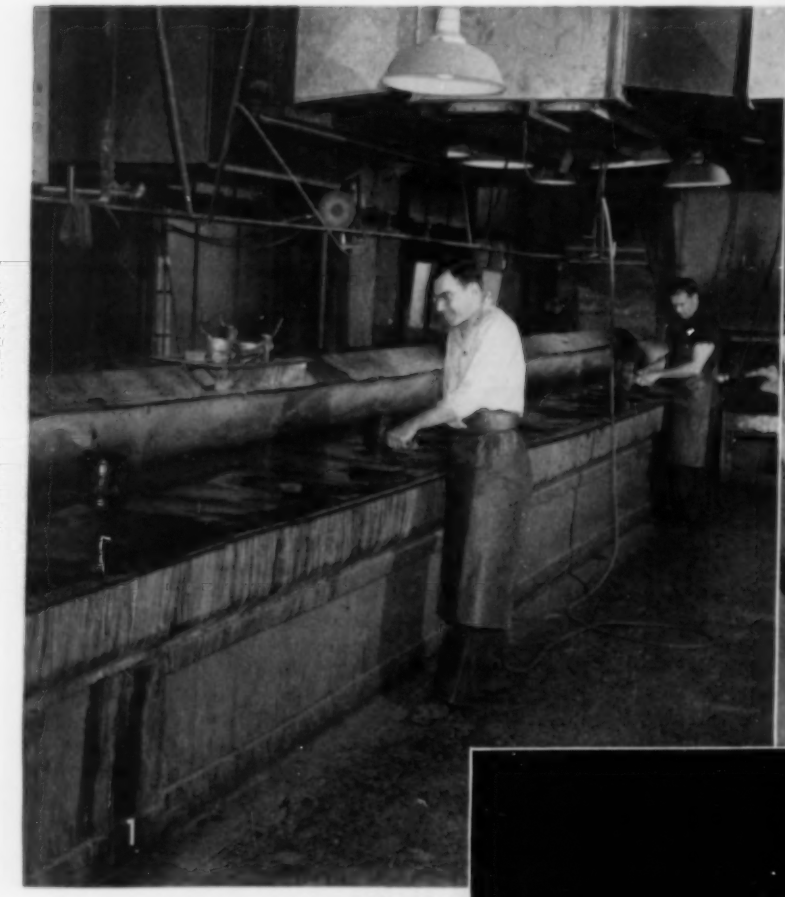


CREEPING EFFECT

The peculiar behavior of liquid helium intrigues and puzzles scientists. If a test tube is lowered into a reservoir of liquid helium at 2.19°K, the helium will climb into the vessel (A in drawing). If the test tube is then raised clear of it (B), the helium will creep out of the tube (see also picture at left showing drop on bottom of tube). The speed at which the liquid travels may be determined by timing its arrival at the top wire on the glass bulb (C). When light is directed on vessel D, helium entering the tube at the bottom will spurt out at the top.



Breathing Rubber Tubes Rid Planes of Ice



ICE is a menace to the traveling public, including the man in the sky, for if his plane is not equipped to rid itself of the blanket as it forms it might become heavy enough to send it crashing to the ground. Different types of aircraft de-icers have been developed, and one that has stood up well in service for about twenty years was invented by Dr. W. C. Geer when vice-president in charge of research for The B. F. Goodrich Company. In the meantime it has been improved upon considerably and is now a standard servo-device of many makes of private, commercial, and U. S. Army and Navy planes.

The de-icer is an integral part of the plane and is made of a sheet of stainless steel to which is cemented a 2-ply layer of rubber provided with a series of inflatable cells or tubes of highly stretchable rubber-coated nylon. The tubes are arranged lengthwise between the plies to insure a smooth exterior surface. They are expanded with cool, low-pressure air in any desired sequence that is controlled by either a centrally

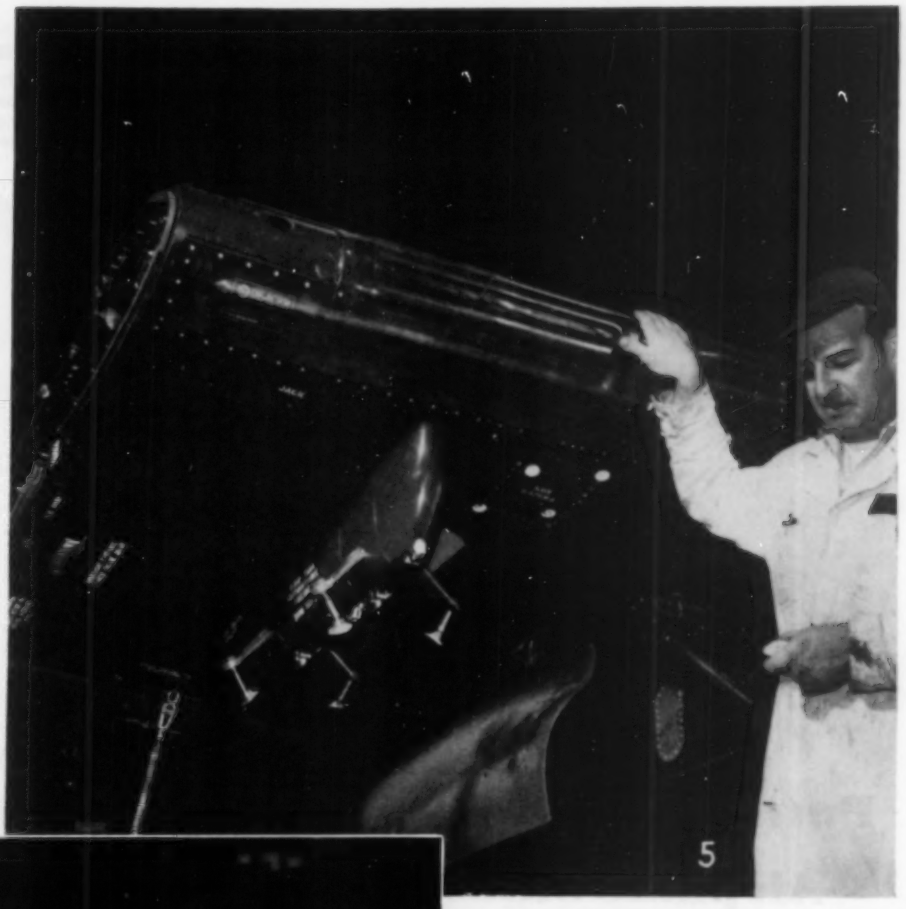
1– The first step in making a pneumatic de-icer is to prepare the sheet of stainless steel that forms the base. After it is polished with air-powered buffers it is coated by a spray gun with several layers of a conductive cement which removes any static electricity built up in the de-icer during flight.

2– The bottom rubber ply, with an adhesive backing, is next rolled on to the metal. The rear worker at the left is pulling away the protective material that prevents the rolled rubber from sticking together, while the one at the right is stenciling an assembly for the layout man.

3– The worker pictured is making the tubes which are the core of the de-icing system. They are designed for a pressure of from 7 to 15 psi.

4– After the tubes are laid out on the bottom ply they are rolled flat and the valves (far end) connecting them to the compressed-air lines are attached.

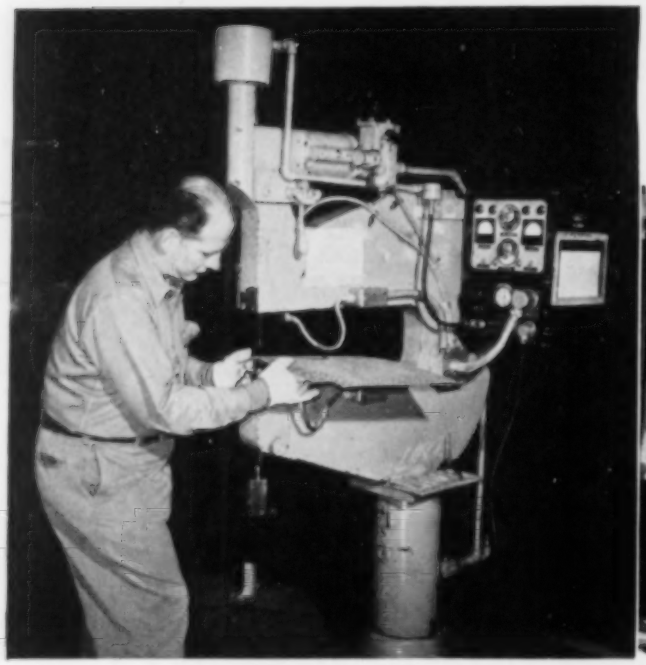
5– All the Navy's high-flying AD Skyraiders are equipped with the most improved form of de-icer system—the Type 11—of which the section shown is a part. It was developed by Goodrich in co-operation with the Bureau of Aeronautics, the Navy and Douglas Aircraft engineers. The technician is timing the pulsations which have been stepped up considerably for more effective service by a reduction in tube diameter and an increase in air pressure.

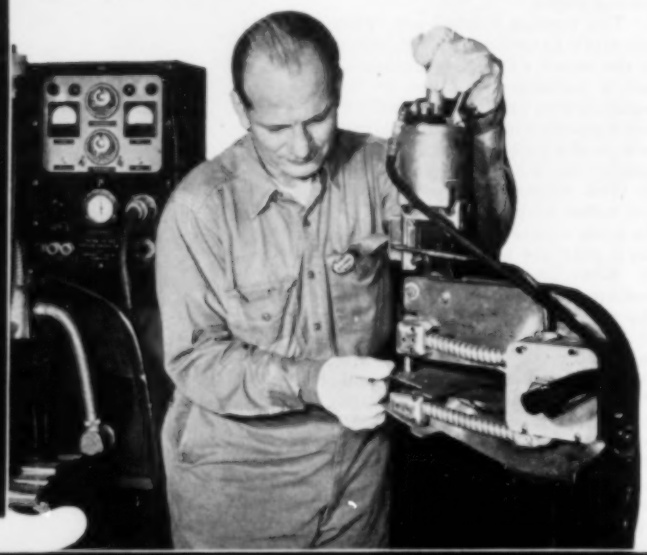


located distributor valve or solenoid-operated valves. In the case of the standard 3-tube system, air is first admitted to the center cell and then, as it undergoes deflation, the two outer tubes expand, the cycle taking place in a fixed time. The resultant pulsations crack the ice, freeing it and allowing the air stream to carry it away. There is usually an inactive period between cycles to permit more ice to form.

The de-icing system is installed in sections along the leading edges of both wings and tail and are connected to the air-supply take-off manifold by small-diameter nonkink hose lines. Only short corresponding sections on each wing function at a time so that any air disturbance caused by breathing tubes will be reduced to a minimum. They are attached to the plane by screws or Rivnuts and are also bonded to the smoothly rubbed down edges by a special rubber cement. This is done to prevent "lift away" no matter at what speed the craft may be flying.

Since the beginning of our defense program, Goodrich has greatly expanded its de-icer production facilities. Several thousand square feet of floor space and new equipment have been added to the department, and the working force has grown from 285 in January, 1950, to 452. It is estimated that there will be 550 on the payroll when output reaches its peak.





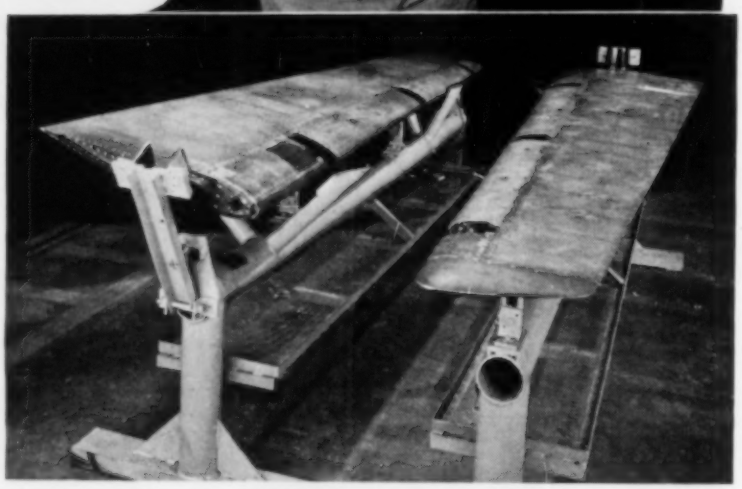
PUTTING IN THE DIMPLES

Shown here are two types of air-operated squeezers with integral die heaters controlled with precision by the electronic instruments in the rear. By combining pressure and heat, the metal is caused to flow to the desired contour in a matter of seconds.

Putting Dimples in Airplane Skins

Air-operated Equipment Bevels Holes for Connector Heads

Robert B. Stanton



WHERE SMOOTH SKIN COUNTS

Elevators for Northrop airplanes. Thanks to flow-form dimpling, their surfaces have no projecting rivet heads to reduce flying efficiency.

HOLES in ferrous or nonferrous sheet stampings that cannot be countersunk are usually dimpled or indented with special dies if the surfaces of the parts must be perfectly smooth in areas assembled with countersunk rivets, bolts, etc. This is not a difficult task if the stampings are of the most ductile sheet metals. But some of the better grades of aluminum, magnesium, titanium, and steel alloys have an undesirable tendency to work-harden and crack when holes are dimpled in the conventional manner (with cold coining dies).

Tool engineers have therefore found it expedient to work out a pneumatic method of heat-forming dimples in the sheet-metal materials that are now being used to fabricate streamlined "skins" for high-speed airplanes. Technically known as "flow-form dimpling," it is being successfully applied on a production scale at Northrop Aircraft, Inc., Hawthorne, Calif.

In the flow-form process, the work is heated by means of electrical-resistance units that are integral with punch and die posts. Die temperatures at the beginning of each operation are relatively high, but are reduced to such an extent by contact with the work that dies and sheet material have approximately the same temperatures at the end of each stroke.

The heat transferred from the tools to the sheet depends on the area of the interface between the tools and sheet, the length of the contact period and the pressure with which contact is maintained. Hence, the amount of heat that should be used in any given circumstance depends on the mass, thermal conductivity, specific heat, mean-temperature rise, sheet thickness and the dimension of the hole to be dimpled.

For example, with 75ST6 alloys, dimpling temperatures range from 300° to 375°F in accordance with the sheet thicknesses and dimple diameters specified for different operations. Higher temperatures could be applied, if necessary, but would damage the materials if held for as long as twenty seconds. Dwell pressure and die temperatures are predetermined by test for each fastener dimension to be used in connection with varying thicknesses of different materials. Then dwell time is ascertained much the same as in spot welding by Tempilac, millivolt, oscillograph and pull-test methods.

No special preparations are necessary to ready a hole for flow-form dimpling. Dirt, paint, grease and other foreign matter do not ordinarily minimize the effectiveness of the new process, and in most cases there is no need of the kind of deburring operations essential with cold dimpling.

Frequently, two or more detail parts are dimpled simultaneously for perfect nesting, a condition that could not consistently be attained if they were dimpled individually. Or, parts with subcountersinks are temporarily assembled with sheet components so that dimples formed in the latter will be satisfactorily nested in the subcountersinks. This is of considerable importance where the gap between faying surfaces on an aircraft structure must be less than 5 percent of the thickness of the thinnest sheet in an assembly joint.

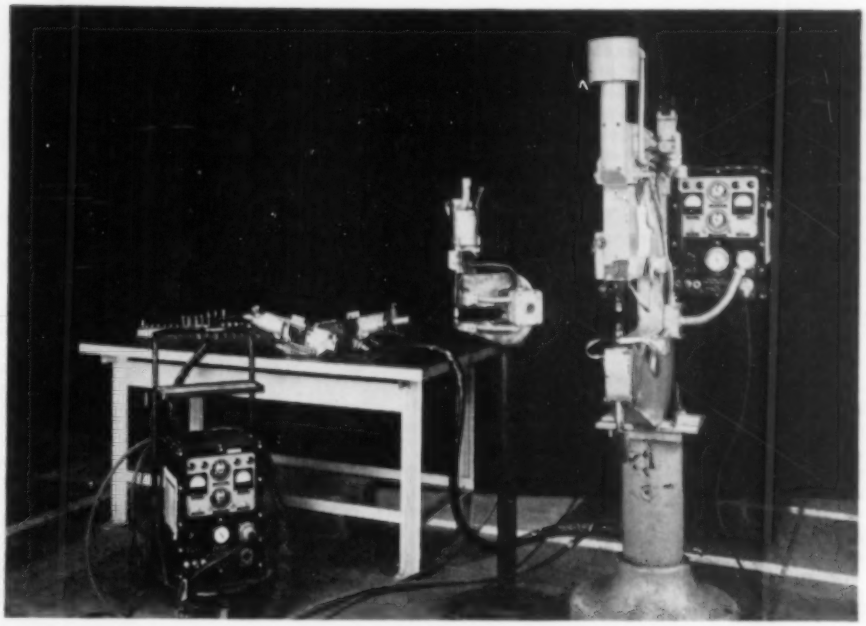
More or less standard tools have been adapted to flow-form dimpling operations performed with the aforementioned heating elements and coining dies. To be explicit:

Where it is practical to bring the work to a machine, a stationary squeezer is utilized. It has a throat depth of 24 inches and a throat opening of 8 inches.

Where the work is not large enough to require a stationary squeezer but too large for a portable dimpler a pedestal squeezer serves the purpose. This unit has a 7-inch throat depth and a 2.5-inch throat opening.

Portable squeezers are often used where it is impractical to take the work to a machine. These tools have throat depths ranging from 0.62 inch to 2 inches and throat openings of 0.62 to 1 inch.

For inaccessible work that cannot be done by any of the machines mentioned, there is a manually operated thermo-bucking bar and rivet gun. Clearances necessary for this equipment are 2.5-inch diameter at the die and 4-inch diameter at a point 5 inches from the end of the die. The over-all length of the bucking bar is 8 inches.



RANGE OF EQUIPMENT

When the work is too large to be readily taken to the dimpler, portable tools such as those shown on the table are used. Smaller pieces are dimpled on either the semiportable unit or the stationary one at the right.

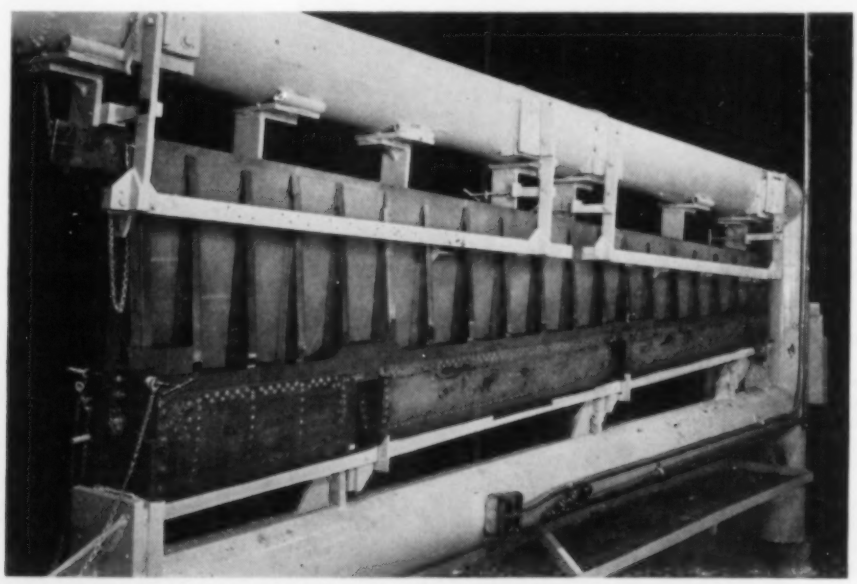
All these tools are powered by air supplied by a centralized factory compressor and each has a thermotronic control unit to regulate the time, temperature, and pressure of each dimpling operation.

The integral heaters for the dies are rugged low-voltage elements which are chromeplated to retain heat and prevent corrosion. Their design is such that there is no danger of electrical shock to the tool operator, and each has a feature that compensates for any slight misalignment of the machine with which it is used. In the base of each die is a thermocouple that makes it impossible to overheat materials when the thermotronic controls are properly regulated.

The form-flow dimpling dies themselves are sturdy, flat-base, hard-chromeplated units, and each is secured by a lock collar for production purposes to prevent the yoke misalignments that might be expected if retainer rings and set screws were used. A pair of these dies can be changed in less than two minutes, and the replacements are ready for service after an additional two minutes of heating time. Extra-length and cutaway dies are provided to dimple hat sections, stringers, etc.

Materials now being dimpled by Northrop in this manner have a maximum gauge thickness not exceeding 0.125 inch, but it is believed that sheets up to 0.25 inch thick can be processed in the same general way. No changes in the usual methods of spacing rivet holes have as yet been specified through the introduction of flow-forming equipment, and in many cases assemblies have been spot welded prior to dimpling.

The new process is not being applied where standard dimpling techniques have been satisfactory because it is a comparatively slow-production method. However, dimples may be flow formed much faster than by countersinking operations where material thicknesses are such that the use of countersinking equipment is optional. Tests to date indicate that where a given part can be dimpled with cold or hot dies, dimples made with the latter have 15 percent greater mechanical strength.



FOR PRECISE ASSEMBLY

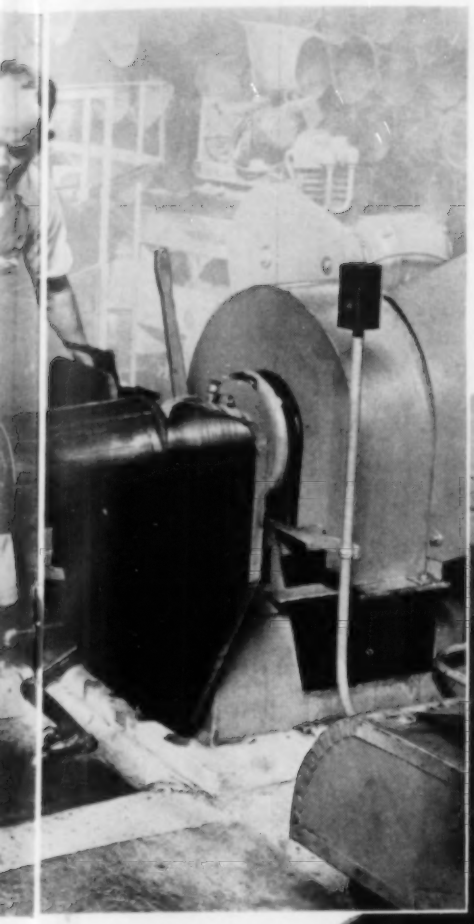
Where it is desired to match holes so that parts will mate precisely when put together, two or more thicknesses of metal are dimpled simultaneously for perfect nesting. Some sections of the assembly pictured were prepared in that way.

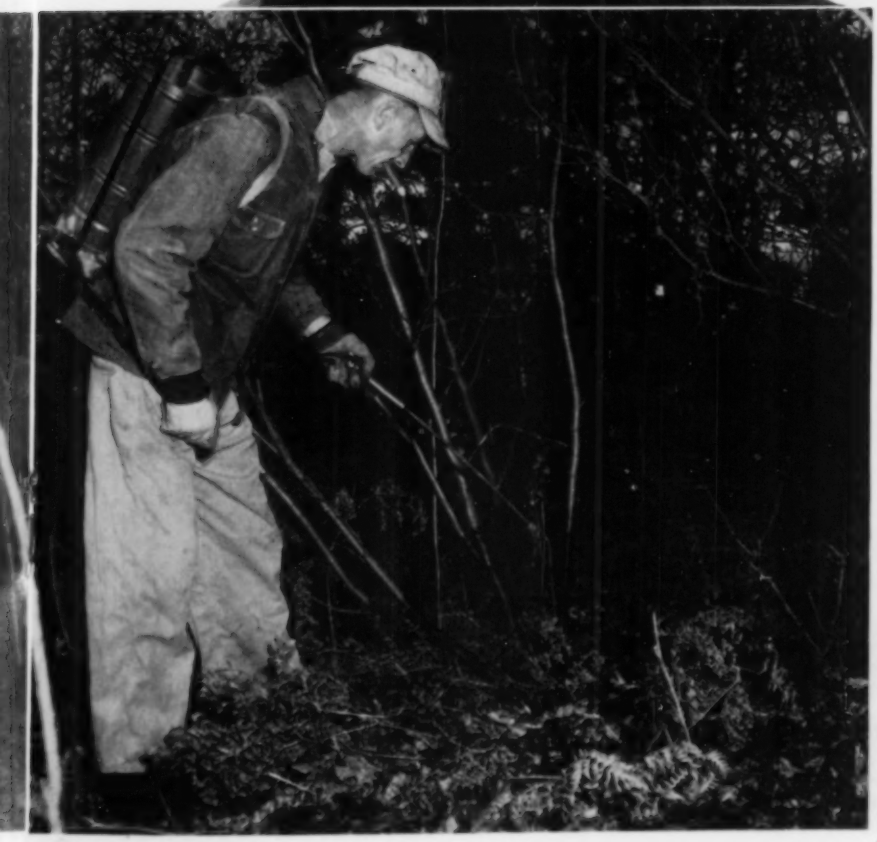
In the view at the right a ton of strip steel, wound on a compartmented 40-inch-diameter reel, has been removed from the rewind arbor on its right and is being laid in a horizontal position by a dolly at the Cleveland, Ohio, factory of Tinnerman Products, Inc. After being lowered, it will be slid off the dolly onto an adjacent roller conveyor for delivery to the inspection department, where the various coils will be taken from the reel and strapped. Four men were formerly needed to lay the loaded dolly back; now the job is done by a 5-inch pneumatic cylinder, which is partly visible. Transfer of the reel to the dolly is accomplished by an air-operated stripper.

Cleaning of metal parts by wet blasting has been gaining favor because the work can be done rapidly and without destroying close tolerances. Many heat-treating shops have adopted the technique for descaling hardened parts of precision-built machines. By using fine-mesh abrasives, as little as 0.0001 inch of surface material is removed and sharp corners and thin-wall sections are not damaged. Below is an action view of the Liquamatte, a new wet-blast machine made by American Wheelabrator & Equipment Company. It uses compressed air at 80 to 100 psi pressure.

The new M-135 military truck at the right, which is being produced for the Armed Forces by the Truck and Coach Division of General Motors Corporation, is an improved version of the same manufacturer's 500,000 "Army Workhorses" of World War II. The new model not only can travel 58 miles an hour on good highways when carrying a 10,000-pound load but, being provided with "snorkel" and sealing devices, can also run submerged in deep-fording operations. When moving in a stream, compressed air at a pressure of 3 psi is delivered from two tanks to axles, transfer case, and transmission and engine compartments to keep the water out.

COMPRESSED AIR AT WORK





Cores used in molds for making metal castings must in most cases have small vent holes to release gases that would otherwise cause a "blow" and do irreparable damage. If the cores are made with the vent holes in them, the latter may subsequently become clogged and fail to function. Such troubles can be avoided by putting the vent holes in afterwards, as illustrated above. This is done in a jiffy with a small Ingersoll-Rand air drill, which can also be used in the foundry for making holes for chill nails, cutting grooves and gutters in molds and for other jobs.

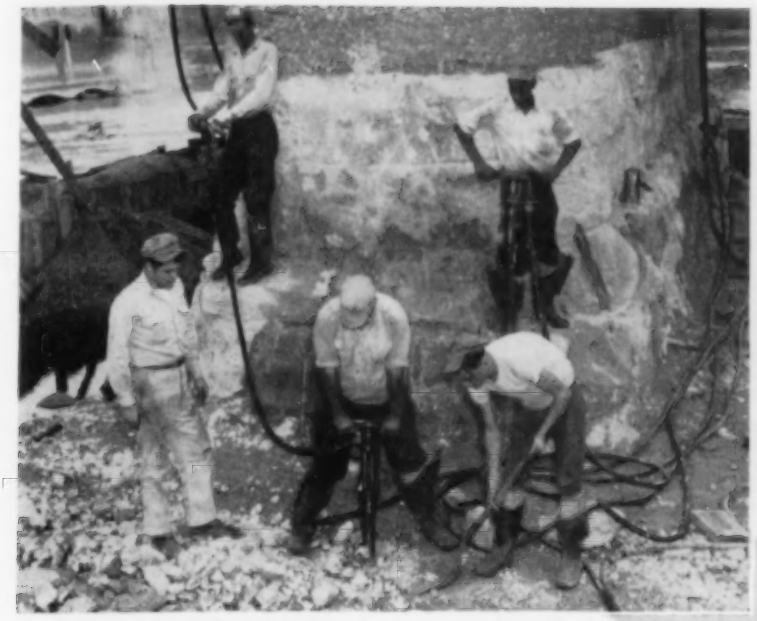
●

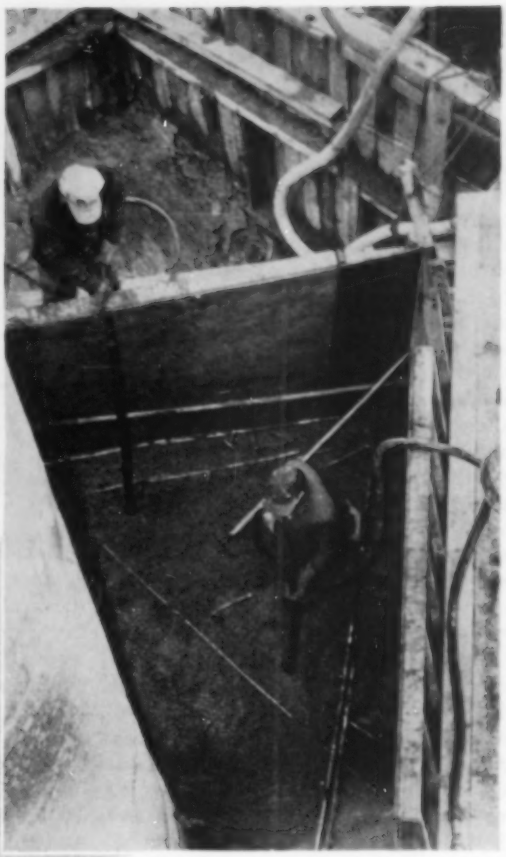
Unwanted woody vegetation can now be controlled without resorting to muscular grubbing. With portable pressure sprayers, like the one pictured at the left, killing chemicals such as 2, 4-D and 2, 4, 5-T can be applied to tree stumps and basal parts of growing brush during the dormant season with little expenditure in time and energy. Apparatus of this type is used widely by farmers, utility companies, highway-maintenance crews and others. The sprayer is operated with compressed air supplied by a built-in hand pump.

PHOTO FROM THE DOW CHEMICAL COMPANY

WHEN NATURE CO-OPERATED

The upper view shows the bridge at Zanesville during the final stages of the surgery on its supports. The bases of the two far piers had been rebuilt and their surrounding cofferdams removed. In the foreground, concrete was being poured into 10-foot-high forms to enlarge the base of the third pier. The operations were completed on December 1, and heavy rains followed. A few days later the river was the raging torrent pictured at the bottom.





WORK ON PIER BASE

After an enclosing cofferdam had been built and unwatered, the old basal concrete was broken out with paving breakers and 6-foot grout holes were drilled with Jackhamers (above). A new concrete base was then poured, the mix being compacted with air-operated vibrators (right). Where the flared concrete collar joins the stone pier, a groove was cut with an Ingersoll-Rand chipping hammer (below) and the bond made watertight with Carey-Lastic.

Air Tools Beat High Water

Modern Equipment Helped Finish Bridge Repairs Before Rains Came

William H. Gottlieb

WITH a full complement of air-powered equipment to speed the job, the George E. Detzel Company rebuilt for a large eastern railroad three concrete piers and one of the abutments of a 580-foot bridge at Zanesville, Ohio, beating threatened high water by the narrowest of margins. The project was begun on August 22, 1951, and completed on December 1. The next day the rising waters of the Muskingum River inundated the last of the four cofferdams involved in the undertaking.

The steel span was originally supported by three stone piers, which were badly damaged when the structure was washed out in the flood of 1913. When rebuilt, the bases of the piers were encased in concrete. Through the ensuing years the supports were eroded by the swift current of the Muskingum, and in 1951 it was decided that their foundations needed strengthening if railroad traffic was to be maintained on the busy line. When work was begun, it was discovered that a large part of the footing of one of the piers had been washed away.

The problem confronting the contractor was that the three piers and the east abutment had to be repaired before the usual rainy season raised the river level and made operations impossible. To meet this deadline, he put as much manpower and equipment on the job as could be employed efficiently. Once a cofferdam was pumped out, as many as 40 men were set to work on a 3-shift basis. Starting on the westernmost pier in relatively shallow water, they first constructed a sandbag cofferdam around it and unwatered the area with air-driven Ingersoll-Rand No. 25 sump pumps. Next, using paving breakers of the same make, they removed what remained of the concrete collar and dug a trench 3 feet wide and 4 feet deep around the entire perimeter of the pier to reach bed rock, which was then solidified by pressure grouting to an added depth of 4 feet. The grout holes were put down with pneumatic Jackhamers, which also served to drill 6-foot holes for a similar purpose into the stone pier in rows 3 feet apart and at intervals of 5 feet circumferentially.

On September 1, after dowels and reinforcing steel had been put in position, 49 cubic yards of ready-mix concrete was poured for the footing by means of a Pumpcrete machine. Forms 10 feet high were then built on the footing, and on September 17 a total of 127¾ yards of concrete was placed for the collar at the rate of 15 yards per hour. That also was done by the Pumpcrete machine, and two I-R Size IV vibrators were used during the pouring operations to produce a strong, uniform mass, to promote hardening and to insure a firm bond between the concrete and the reinforcing steel. After a 2-day setting period and removal of the forms the concrete was sprayed with a curing compound. The collar slopes away from the stone pier, and at the joint between

the two materials a groove, 1 inch wide and 2 inches deep, was cut with air-powered chipping hammers and filled with Carey-Lastic.

The collars were anchored to the piers by 1-inch dowels which were inserted into the holes drilled in the stone during the grouting operations. The new concrete was reinforced with ¾-inch vertical steel bars tied to steel dowels in the pressure-grouted rock bed. In addition, two staggered rows of ¾-inch deformed steel rods were placed horizontally, one 6 inches from each pier and the other 6 inches from the outside face of the concrete. Footings and collars vary somewhat in size in accordance with the conditions of the water and the river bed. The eastern pier, the largest, is 50 feet long, 10 feet 9 inches wide at the bottom, and tapers as it rises. It required a footing 10 feet deep on the upstream end, sloping to 5 feet downstream. The collar extends to a point 12 feet above the river bed.

For the midstream pier the contractor had to build a 6-foot sandbag dam, which was unwatered by four air-powered sump pumps and two 4-inch pumps driven by gasoline engines. The footing, containing 109½ yards of concrete, was poured on September 26 and the 83-yard collar on October 3.

The eastern pier stood in water as much as 12 feet deep and necessitated the construction of a wooden-framed cofferdam 100 feet long, 60 feet wide and 12 feet thick. Twenty-six carloads of material was required to fill the area between the inner and outer walls of the dam. From the worktrain on the bridge, it was washed down two chutes and spread with water obtained from the river and raised to a height of 33 feet by an air-operated high-lift sump pump. At the same time pumps discharged water from the cofferdam. After the preparatory work, which was essentially the same as already described, the footing was placed on October 21 and the collar nine days later. A total of 224½ cubic yards of concrete was needed for this pier.

SOURCE OF AIR

This Ingersoll-Rand 600-cfm Gyro-Flo compressor furnished air at 110 psi pressure for operating the tools. From the left, the men shown are Victor Anderson, compressor operator; Ollie Privett, job superintendent; and Robert Morris, carpenter foreman.

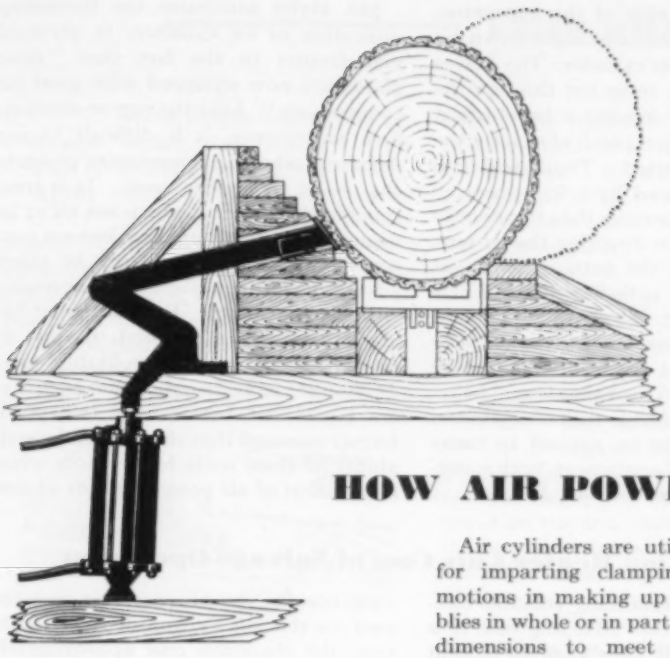
Operations on the east abutment were started on November 5 with the building of a cofferdam, after which all loose and disintegrated rock supporting the abutment was removed and the footing area excavated and cleaned out. It was found that the stones on which the seat rested had been eroded to a depth of 2½ feet. No sooner had the job of cleaning the excavation been completed when the river rose and washed out half the cofferdam. It was reconstructed and the area again cleaned out.

As in the case of the piers, holes were drilled into the rock, heavy dowels and reinforcing steel placed, and forms built. On November 17 a footing of 82½ yards was poured, and four days later, with the placing of a like amount, the concrete work was finished. The entire project was completed on December 1. Heavy rains followed immediately, and the Muskingum rose rapidly, submerging the last cofferdam. The contractor will probably be saved the expense of clearing it away.

Air tools and air power played an important part in the speed with which this urgent job was carried to conclusion. Besides the sump pumps for moving fill and unwatering cofferdams, the vibrators for setting concrete, the pavement breakers for removing old concrete and stone and for trench digging, the Jackhamers for rock drilling and pressure grouting and the chipping hammers for cutting grooves, the George E. Detzel Company used air drills for wood boring in constructing the cofferdams and forms, a pneumatic grinder for dressing tools and making bolts, and Multi-Vane motors, one for driving the grout mixer and another for the Gunite machine. Despite the fact that all were dependent upon a single I-R Gyro-Flo compressor delivering 600 cfm at 100 psi, the project was never starved for air.

BUILDING A COFFERDAM

To enclose the easternmost pier, a wooden-framed cofferdam with double walls 12 feet apart was constructed. Twenty-six carloads of earth was required to fill the intervening space, and was chuted down as shown here from railroad cars run on the bridge.



LOG KICKER

Mechanism used at New Westminster, B.C., by Pacific Veneer Division of Canadian Forest Products Company to remove logs from a trough in which they are hauled up an incline from the storage pond. When the mill is running at capacity, the kicker operates several times a minute. It is actuated by a Nopak air cylinder made by Galland-Henning Manufacturing Company.

HOW AIR POWER HELPS MAKE PLYWOOD

NEW applications for compressed air are being found continually in most branches of industry, and factories engaged in making plywood and veneers are no exception. The growing use of pneumatic cylinders in such establishments is pointed out by John E. Hyler in an article in *Southern Lumberman* published in Nashville, Tenn.

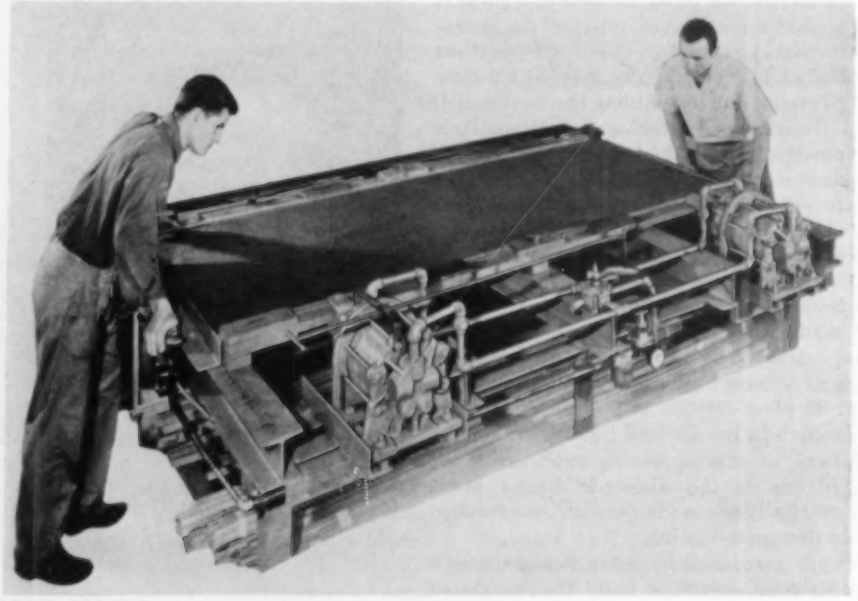
In some plants air power is brought to bear in the first operation involved —that of getting logs into the building. From a storage pond, logs are hauled up a jack ladder through a trough and, upon reaching the top, are "kicked out" just as they are in many sawmills. The kicking mechanism is often actuated by compressed air through the medium of a pneumatic cylinder because the latter provides the reciprocating motion that is required. An accompanying illustration shows the arrangement of a kicker of this type. The logs roll to the bottom of a ramp, and from there they are started on the journey that reduces them into thin sheets.

Hoists or lifts powered by air cylinders are installed in some factories to handle whole logs or "bolts," which are sections or blocks of logs cut in sizes to fit the available reduction machinery. Usually suspended from a monorail, crane, or other medium of transportation, these units make it possible closely to control the hoisting height and are therefore well suited for bringing a log or bolt to the level necessary for accurately "dogging" it on centers in a rotary lathe, which literally peels off thin sheets as it revolves. In another setup, logs or bolts are moved into cutting position from a runway at one side of the lathe by a mechanism that is operated by pneumatic and hydraulic cylinders.

Air cylinders are utilized extensively for imparting clamping and pressing motions in making up veneered assemblies in whole or in part. Clamps vary in dimensions to meet different needs. Some with wide jaws are employed for "plying up" or veneering pieces that are relatively narrow. Work wider than 24 inches and longer than 32 is normally handled in standard vertical presses. Pneumatic clamps are sometimes used to apply the pressure required in gluing sheets together. With that done, mechanical retainer clamps are put on to hold the pressure until the glue has dried. One set of air clamps, which usually includes two cylinders, can thus serve successive assemblies as fast as they can be handled.

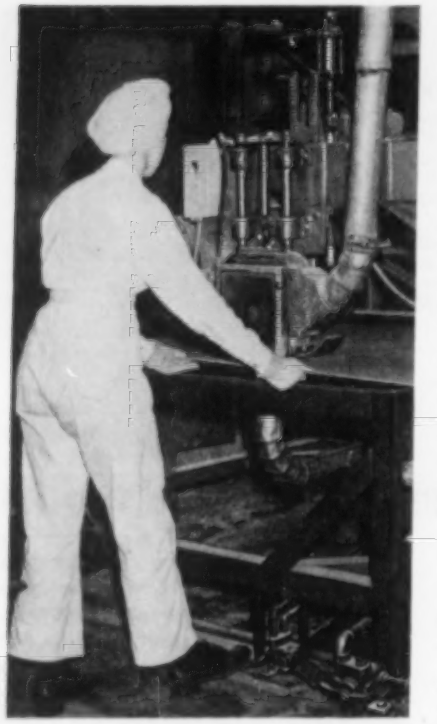
Pneumatic clamps are likewise a feature of some modern electronic presses of the batch type. In that case a bank of cylinders is tied in with the operating cycle, which is largely automatic. One such press has a foot pedal to trip a solenoid valve that starts the cycle. A ram pushes the wood-and-glue sandwiches between the press platens, where they are automatically centered at the end of the stroke. When fully extended, the ram releases a limit switch that reverses its direction, causing it to return to the starting point. The ram also trips a solenoid valve by means of which the side-squeezing air cylinders and the descending press platen are brought into action.

The high-frequency electric current that provides heat for setting the glue is regulated by a timer that can be adjusted in accordance with the number and the thickness of the sheets to be



SPECIAL PRESS

One of many air-operated machines developed by the industry for imparting pressure. In this case power from two Hanna pneumatic cylinders is squeezing reinforcing tubing on to the edges of plywood panels in the Chicago plant of Woodall Industries.



PATCH-POCKET CUTTER

In the head of this machine are several knives that cut surface defects from veneer panels so that they can be patched by inserting matching pieces. The "Nopak" cylinder at the top moves the cutter up and down. It is controlled by a foot valve, and the operator's hands are free to position the panels.

bound together. When the timer cuts off the current it also reverses the solenoid valve that controls the application of the side and top pressure, thereby releasing the work. As the ram moves a panel into the press, the one just glued is pushed out ahead of it. After the operator has depressed the foot pedal and set the cycle going he can devote his time to gluing and assembling the next panel.

In all the squeezing operations it is possible, within the limits of the cylinder diameter and the air pressure available, to adjust the pressure as needed to achieve the best results. The pressure exerted per square inch decreases as the area to which it is applied increases. Some of the most effective glue joints are made with around 200 psi. With the press referred to, pressures up to 500 psi are obtained by using 9-inch cylinders and plant-line air at 80 psi. A pressure switch in the air-feed line leading to the bank of edge-squeezing cylinders is set to cut in the dielectric heater automatically when the pressure has reached a designated point.

A pneumatic cylinder also actuates a plywood cutter, a knife that works at high speed to reduce moving sheets into pieces of specified size. Another machine carries a cutterhead with several blades and is used to cut defective areas out of plywood. The sheet to be repaired is laid out flat on the table of the apparatus, and the cutterhead is brought down by the action of an air cylinder. The knives are controlled so as to cut through the top veneer only, leaving a bevel-edged pocket into which a patch of exactly the same size is inserted. The machine is started and stopped by a foot-operated air valve, which permits the attendant to use both hands in directing the cutters.

In conclusion, the author points out that pneumatic cylinders are suitable for service most anywhere in a plant where pressure has to be applied, the number required depending upon the work in hand. "This being true," he reports, "it is inevitable that air cylinders and valves would be applied to many different types of equipment, both standard and out of the ordinary."

Mr. Hyler attributes the increasing utilization of air cylinders in plywood manufacture to the fact that "most plants are now equipped with good air compressors." Like the egg-or-chicken-first controversy, it is difficult to say definitely whether compressors promote the use of air or vice versa. It is true, though, that once a factory has air at its disposal, additional applications are continually being found and can be taken advantage of if sufficient compressing capacity is available. Probably what has happened is that plywood makers, as more ways to use air profitably were developed, have bought machines that are larger and better built than their former ones and that the greater dependability of these units has led to a wider application of air power in their plants.

Induction Heater Cuts Cost of Salvage Operation

THE cost of reclaiming valuable metal from weather stripping has, it is claimed, been cut more than 90 percent at the Sponge Rubber Products Company of Shelton, Conn., which makes such stripping for automobile doors and trunks. Because of the difficulty in getting rubber to adhere to metal, rejections are heavy—from 20 to 30 percent.

To salvage the metal strips, the discarded work was formerly soaked for several hours in a chemical solvent. This caused the rubber to swell and permitted it to be peeled off by hand. However, the solution was highly flammable and gave off toxic fumes so that constant vigilance had to be exercised and the men on the job safeguarded. In addition, the chemicals cost approximately four to five thousand dollars a month.

By the present setup the rejects are placed on a conveyor belt, passed through an inductor coil connected to a General Electric 5-kw induction heater and stripped immediately by a gloved workman. According to the company, the cost for power is approximately ten cents an hour, and with the heater running from six to seven hours it is possible for one man to process nearly 6000 strips. The equipment paid for itself the first month it was used.

U. S. ARMY PHOTO

AERIAL TRAMWAY IN KOREA

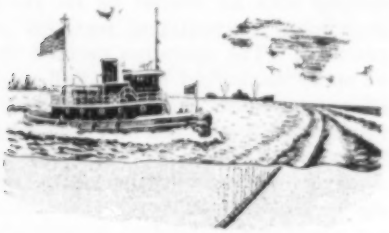
The Army borrowed an idea from the mining industry and the skiing fraternity to supply transit facilities in a rugged section of Korea. Personnel of Company D, Third Engineers Construction Battalion, Ninth U. S. Corps, built this aerial cableway up a steep 1530-foot incline on the main line of resistance. The picure shows a car arriving at the upper station.

This and That

Russia Does It Again

According to *Newsweek Magazine*, the Russians have made another great "invention." This one is a "tricky new kind of harbor breakwater." It involves blowing compressed air into submerged perforated tubes, and the bubbles rising from them "are supposed to reduce the size of the waves."

This should interest Philip Brasher, who conceived, patented, and placed in successful operation several systems of



this kind as long as 45 years ago. We first wrote up this development in 1907, and have published several articles on it since then. The longest of these, one that appeared in January, 1921, under the title *Smashing Angry Seas with Bubbles of Compressed Air*, established a record: through the years, more requests have been received for it than for any other article ever printed by us. We still get calls for it, but can furnish only photostats because our supply of that issue was exhausted long ago.

* * *

Kanthal Thrives on Heat

At the Degerfors steel works in Sweden in 1916 Hans von Kantzow was attempting to determine the carbon content in a steel bath by measuring the electrical resistance. One day he forgot to remove from the furnace a piece of steel-aluminum alloy and the tongs with which it was handled. By the time he returned, the tongs had melted but the test bar was intact. This puzzled the young engineer, because aluminum has a low melting point for a metal. He investigated and found that the addition of aluminum to steel not only improves its heat resistance but also increases its specific electrical resistivity. After further research, he applied in 1926 for patents covering a wide range of iron-aluminum alloys, with additions of other metals such as chromium and cobalt.

In 1931, Kantzow began the commercial manufacture of Kanthal, which forms the glowing element in many automobile cigarette lighters, electric ranges and other appliances. The factory, which observed its twentieth anniversary in December, now employs 900 persons and exports 90 percent of its output. To supply the American market, a small branch factory has been established in Connecticut. Kanthal, it is claimed, excels other alloys in withstanding high temperatures (up to 2462°F) and reaching them rapidly.

* * *

Atomic Energy Notes

To the practical by-products resulting from atomic-energy research may be added a new instrument for measuring the thickness and weight of sheets of paper, cardboard, plastic, textiles, metal foil, etc. The device is based on the fact that beta particles of radioactive substances are readily absorbed by materials placed in their path. It operates on the comparative principle, that is the thickness of the material being investigated is compared with that of a test sample of known thickness. The instrument, called the Beta-Comparator, is manufactured in Stockholm, Sweden, and is claimed to be accurate to within 1 percent. Also from Sweden comes the announcement that specially developed neon and oxygen isotopes produced by the Department of Nuclear Research of the Swedish Nobel Institute are being sent to the United States to be bombarded with rapid particles at the California Institute of Technology. They are making the journey embedded in sheets of silver which are, in turn, encased in vacuum containers.

* * *

Husbands Will Go for This

For several years the Gebhardt Coal & Coke Company, of Erie, Pa., lost business because more and more people were turning from coal to gas or oil for heating their houses. Investigation disclosed that the gaseous and liquid fuels were preferred because they eliminated the chore of disposing of ashes. It was plain that lost customers could be rewon and new ones gained only by devising some way by which coal-burning plants could be operated automatically.

After four years of effort, Gebhardt has come up with a vacuum ash-disposal system that seems to provide the answer. From the stoker-fired furnace grate the ashes go either into a pit excavated in the floor or into a metal container that rests on the floor. Twin 3-inch tubes rise from the bottom of the storage receptacle to the ceiling and then run laterally to and through an outside wall at a point convenient to a driveway.

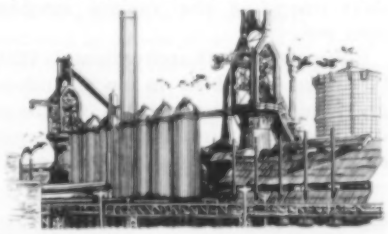
Every now and then the company sends around a truck equipped with a vacuum tank and a blower driven by power take-off from the vehicle's engine. Hoses are used to connect the discharge and suction sides of the blower housing with the tube openings in the wall. When the blower is started, the air stream, which is powerful enough to carry solids such as pieces of brick, quickly empties the ashes into the truck's vacuum tank and they are hauled away for disposal.

The charge for this service is included in the cost of the coal, which the customer pays on delivery. One truck can take care of about 200 domestic furnace installations. Only a driver is required, and in most instances he does not have to enter the house. No dust is liberated at any time to permeate the house, and women like that. So far the system has been applied only in Erie, but the company plans to extend its operations.

* * *

This Hot Air Is Useful

In slang, the term "hot air" generally has a derisive ring and denotes tiresome talk of no great benefit to anyone. Real hot air, on the other hand, does important and at times indispensable work. Consider, for instance, its role in making pig iron, the basic material for the vast foundry and steel industries. In addition to charging



a blast furnace with around 3.15 tons of solid materials (iron ore, coke, limestone) for each ton of iron produced, approximately 3½ tons of air, compressed to 20 psi or higher and heated to 1100°F, is blown through it. In a recent month the nation's blast furnaces turned out 6,197,176 net tons of pig iron, a new high mark made by operating the stacks at 100.6 percent of their theoretical capacity. As their contribution to this output, the blowers handled 21,690,116 tons of air.

* * *

Air Aids Oil Well Drillers

Several oil-industry trade journals have lately publicized well-drilling operations in which compressed air was substituted for drilling "mud" as a means of removing cuttings from the hole, cooling the bit, and maintaining pressure to prevent blowouts in case gas is struck unexpectedly.

The technique is similar to that used by seismograph crews of geophysical prospecting parties for drilling "shot holes" and was described in our January, 1951, issue. In the recent instances, however, the holes have been full-fledged oil wells reaching to depths exceeding 7000 feet, whereas the geologists' holes normally go down only 100 to 200 feet.

Air was used by the Penntex Oil Corporation to drill 922 feet of hole in Martin County, Texas, and by the Wilshire Oil Company, Inc., to penetrate to a depth of 108 feet in Upton County, Texas. The first-mentioned well was abandoned when it failed to find oil, and work on the second one was necessarily suspended when the tools were lost in the hole.

The experiments with air were undertaken because of the escape of drilling mud in the fractured and cavernous Sprayberry oil-bearing formation in west Texas. In a previous case, the Wilshire Company succeeded in overcoming this loss by aerating the column of mud in the hole. Following this experience, natural gas was used successfully instead of mud in a well in the San Juan Basin of New Mexico. The results obtained led to the tests with air.

Consideration was given to either natural gas or LPG (liquefied petroleum gas) in the Penntex and Wilshire wells, but the volume of natural gas available was insufficient and facilities for handling large quantities of LPG were lacking. Air was therefore chosen. At the Martin County well, ten small 2-stage compressors delivered air at 100 psi pressure to three larger single-stage boosters that discharged it at pressures up to 600 psi. After the initial stage of compression, the air was passed through an aftercooler. The installation provided 1,000,000 to 1,500,000 cubic feet of air per day.

At the Wilshire well three 500-cfm machines were substituted for the ten small units, and the average daily output was 900,000 cubic feet at 200 psi pressure and 150°F temperature. Encouraged by the tests, Wilshire has ordered a 200-hp, 2-stage compressor capable of supplying daily approximately 1,250,000 cubic feet at 380 psi.

When conventional drilling fluid is used, it is sent down the hollow drill pipe, emerges from the bit, and then rises to the surface in the annular space between the drill pipe and the casing. With air the results seem to be better when this routing is reversed.

An insurance company that was consulted before the experiments were begun reported that the risks run when drilling with air should be no graver than when conventional methods are practiced. The operators decided that oil spray discharged from a well might offer the greatest danger. As a precaution against fire in such an event, floodlights were erected to illuminate the working area and all lights on the drill rig were extinguished.

Salesmen Operate Machinery for Four Days

ACTION replaced words at the annual sales meeting of the Rish Equipment Company, which sells heavy construction machinery through six branch offices in Virginia, West Virginia and Ohio. Instead of listening to conventional pep talks and engineering discussions, the firm's 80 officials and salesmen donned work clothes and spent four days operating the various machines they sell.

Equipment worth approximately $250,000 was assembled in an abandoned gravel pit at Richmond, Va., for the unusual course of instruction. It ranged all the way from small pumps and air-powered tools to a 20-ton bulldozer, said to be the largest of its kind. All manufacturers coöperated by sending factory and fieldmen to serve as teachers and demonstrators, and a "faculty" of 44 was on hand.

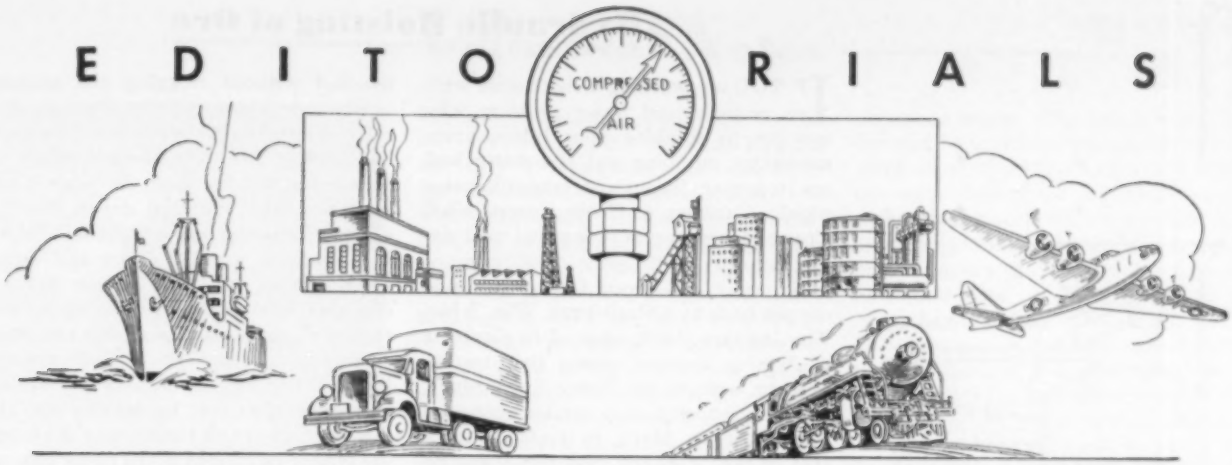
The salesmen were routed out of their hotel each morning at 6:30 and transported in buses to the gravel pit for an 8-o'clock start. Each noon they ate a hot lunch in a tent on the premises. The equipment was divided into eight sections and the "students" into eight groups each of which spent four hours in a section and changed to another one in the afternoon. Six Rish servicemen kept all machines functioning properly.

"Operation Field Experience," as it was termed, was conceived and directed by H.D. Anderson, Rish vice-president who is known for his sales-training innovations. In 1950 he chartered two buses and took his sales staff on a 2300-mile tour of the factories that make the equipment the men sell. As a result of this year's school, he declared, they are bound to handle their work better, and added: "They developed a respect for skilled operators and found out what the machines are capable of doing. Now they can operate every machine they sell."

LEARNING THE ROPES

A late model Ingersoll-Rand Gyro-Flo diesel engine-driven 300-cfm portable compressor (above) furnished compressed air for operating rock drills and other tools. Blocks of rock were hauled in and the holes in them are evidence that the drills were kept busy. At the right, William Moir, Rish Company salesman at Lewisburg, W. Va., is shown getting some pointers in running an FM-3 wagon drill from R. C. Harris, Ingersoll-Rand representative.

EDITORIALS



OLD IDEA CROPS UP

IN CONNECTION with gas-turbine research, an old idea is being reëxamined in several European countries. The economies that can be effected by obtaining compressed air for such a turbine from a hydraulic compressor has attracted the attention of several investigators.

Other than bellows, the hydraulic compressor was probably the first device used to put air under pressure. In the form of the trompe, it compressed the blast for operating Catalan forges in the Middle Ages. A few large compressors based on the same principle were built in this country and Canada around the turn of the century, and it is reported that one of them is still in service. In such a system, it will be remembered, water falling down a shaft entrains air, compresses it by the weight of the column, then releases it at the bottom where the shaft widens out into a cavern. The air trapped between the water level and the roof is piped to the surface for use, while the water rises through another shaft and flows away.

A compressor of this type is highly efficient and economical, and gas-turbine designers would like to take advantage of these characteristics. Unfortunately, there are few places where there are ample water and suitable topographical conditions for constructing such a compressing plant at reasonable cost—much excavating being required. There are still fewer favorable sites where gas-turbine power could be applied to worthwhile work.

Even where suitable natural conditions prevail, it would still be necessary to have a water flow that would not fluctuate too widely, for the efficiency of the gas turbine is predicated on operating at full load and drops off appreciably when the load decreases. Then too, it must be remembered that wherever a sizable volume of water can be put under a head it could be harnessed to produce power in an impulse turbine. In other words, the potentialities of falling water are not confined to compressing air.

Therefore it does not seem probable that there can be many satisfactory unions between the gas turbine and the hydraulic compressor. It is interesting, however, to note that the idea involves the linking of one of the oldest and one of the newest of man's contrivances for producing power.

TRANSITION IN CANADA

THE development of petroleum and natural gas in the Province of Alberta is exerting a great influence on the economic life of Canada as well as on the geographic distribution of its inhabitants. Although gas can and probably will be piped to large cities far away, it is not economical to transport it to thinly settled areas to the north. Nevertheless, in these sections are mining enterprises of considerable magnitude that could profitably use natural gas as fuel. Since gas cannot be brought to them, they will most likely transfer some of their metallurgical operations to Alberta.

Last month's issue told of a plant to be built by Sherritt-Gordon Mines Ltd. for leaching nickel-cobalt concentrate to be obtained from its new mine at Lynn Lake. At that time its location had not been fixed, but since then it has been announced that it will be Fort Saskatchewan, 11 miles from Edmoton. Though the site is hundreds of miles from the mine, it will be economical to ship the concentrate to cheap fuel.

This is only one of many similar movements under consideration. Both Consolidated Mining & Smelting Company, base-metal producer, and Eldorado Mining & Refining Company, crown-owned uranium producer, are contemplating transporting concentrates to Alberta from their far-north workings. The situation in regard to the processing of metals is akin to that which made Pittsburgh the center of steel manufacture. The city had fuel and was near major markets, so iron ore began moving there from the Mesabi range.

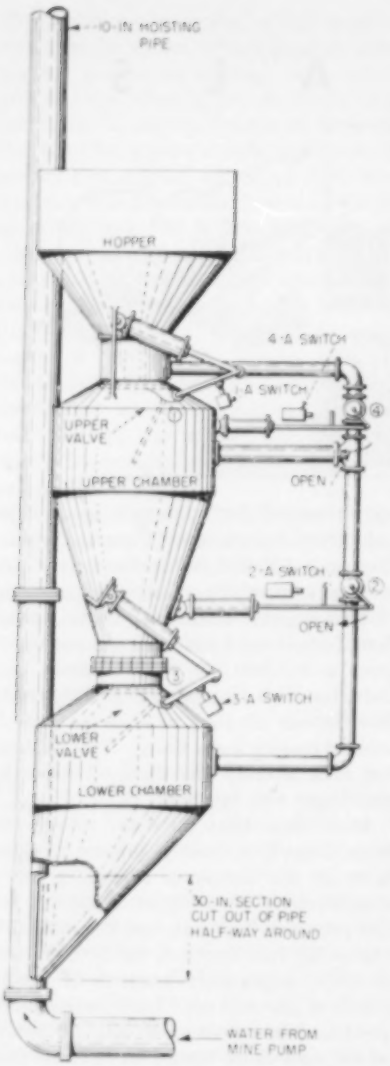
Other industries than mining are being attracted by Alberta's gas. The Celanese Corporation of America is putting up a $50,000,000 factory near Edmonton to produce cellulose acetate and various organic chemicals. Also, Canadian Industries Limited is preparing to erect a $13,000,000 plastics plant and Canadian Salt Company is getting ready to turn out 20 tons of chlorine and 24 tons of caustic soda daily. The Edmonton area already has three oil refineries and there will be more.

It is clear that Alberta, though far from Canada's most populous sections, is to be the center of certain types of manufacture. In addition to oil and gas, the province has coal, but the output of this solid fuel declined by 500,000 tons in 1951, apparently because of the inroads of gas and oil. Last year Alberta produced in excess of 40,000,000 barrels of oil, and more would have come from the ground if means for handling it had been available. As facilities for piping it eastward increase, output will rise.

While industry is moving westward and southward, mining is steadily pushing northward. Airplanes and geophysical prospecting have jointly helped miners edge into the land of permafrost. Mining costs are a little higher than farther south, but when large tonnages are involved they can be held to surprisingly reasonable levels. Even gold mining, which is struggling under the burden of a fixed price on its product that has not changed since 1933, is finding it possible to invade the North. The record holder now is Discovery Yellowknife, located 52 air miles north of the town of Yellowknife and 225 miles south of the Arctic Circle.

If the trend continues, some intrepid prospector will one day drive a location stake close to the North Pole. And, if he can chop a hole through the thick ice, some fisherman may set up business there too, although we don't know just what he might catch. In any event, more than 8,000,000 pounds of trout and whitefish taken from Great Slave Lake, north of the sixtieth parallel, was sent to American markets last year.

Hydraulic Hoisting of Ore



IF YOU are working a shaft mine with an underground water problem why not try to combine your lifting operations by pumping out the water and ore together through a large-diameter pipe? Calumet & Hecla Consolidated Copper Company is doing just that experimentally with some 2000 gpm of mine water and about 120 tons of zinc ore per hour at a Shullsburg, Wis., mine. The January, 1952, issue of *Engineering & Mining Journal* covers that test in a story written by Percy S. Gardner, Jr., who reported on a similar operation at Philipsburg, Mont., in the fall of 1950. But in the Montana case there was no excess water, and the hydraulic hoist had two pipes connecting the surface with the underground loading station—one to carry down the water that was needed to bring the ore to the surface in the other.

At Shullsburg, a standard 10-inch pipe installed in a vertical-shaft compartment serves as the hoistway for the water, which is delivered by five pumps from as many underground sumps. The ore is fed into the line through a special loader consisting of an upper and a lower chamber, the latter being connected to the pipe at a point below the haulage level by a 30-inch opening halfway round the pipe. The ore is crushed underground to minus 4 inches preparatory to its 365-foot trip to the surface. However, tabular pieces as much as 10 inches long, scrap pipe, sledge-hammer heads and other tramp material have been handled without clogging the system.

Ultimate plans call for the use of a conveyor to dump the ore from the main haulageway into the loader, which is now being fed by hand in 1- or 2-ton batches. The material drops through a hopper into the upper chamber. When it is charged, a valve closes and water under pump pressure in the bottom chamber is admitted into the upper one through a by-pass, equalizing the pressure in both chambers. Then a valve between the two opens, thus permitting the material to pass by gravity into the lower chamber and thence into the hoisting pipe to be caught in the rising column of water, which goes to a dewaterizer by way of an overflow box.

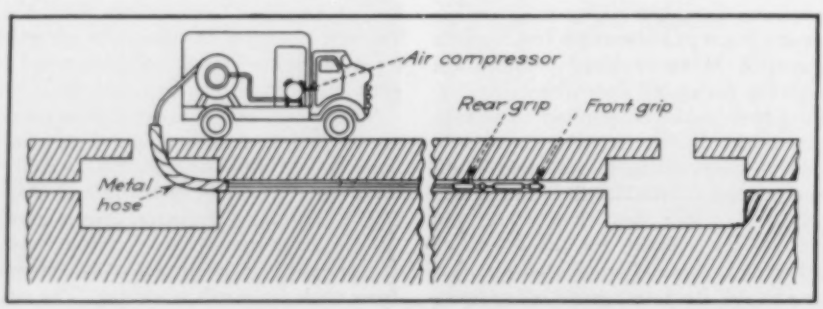
The experiments have proved that an increase of only 500 gpm (to 2500) in the flow will approximately double the ore-carrying capacity—boost it from 120 to 240 tons an hour. No appreciable change was noted either in static pressure on the chambers or in pump power consumption when handling only water or water and ore combined.

In the case of the Philipsburg mine, tests were made with vertical and inclined hoisting systems. The former was found to be far more efficient because it took twice as much power to pump the ore upgrade, and wear on the pipes was appreciable. In view of the fact that these two installations are handling heavy ores satisfactorily, the method would seem to be suitable for hoisting ore, rock, or coal from underground.

Air-Operated Crawler for Rodding Porous Conduits

FOR PULLING small wires through conduits, commonly called rodding, the Commonwealth Edison Company, Chicago, Ill., is using a compressed-air "reciprocating engine" that has solved a problem which confronted it in that area. The device features two air-operated grips, one at each end, which cause it to crawl along, dragging with it an air-supply hose attached to the rear. When air is applied, one grip comes in contact with the duct wall and holds tight while the mole moves ahead. Next, it contracts, and the other grip opens, allowing the mechanism to advance another step. It's a case of push and pull until the end of the conduit is reached. Then the crawler is removed and the wire is fastened to the hose and drawn through the duct as the hose is rewound on its reel.

The work is frequently done by means of a rubber cup which, with the wire attached to it, is blown through with compressed air. This has a disadvantage in the Chicago district because the conduits used there are of precast concrete and therefore not airtight. This is not a drawback in the case of the new method by which loss of pressure is avoided by carrying the air-supply line right along with the mechanism. It is said to go even through ducts partly filled with mud or sand. According to the engineer of the underground division of the company's construction department, the compressed-air engine enables a crew of six men, including foreman and truck driver, to do 75 percent more work in a given time than a gang of nine could accomplish by hand rodding.



ELECTRICAL WORLD

CRAWLER AT WORK

Air supplied by the portable compressor pushes and pulls the rodding machine through the duct by alternately operating the rear and front grips. The metal hose in the manhole, left, protects the air line, which is fastened to the crawler. When the latter reaches the opposite manhole it is detached from the air hose, to which the wire is then secured and drawn through the conduit by rewinding the hose on its reel on the compressor.

Industrial Notes

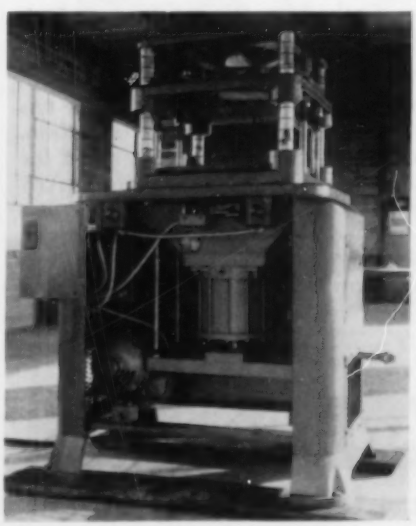
For intermittent or emergency use in industrial plants, mines, ships' holds and other confined spaces, Mine Safety Appliances Company has designed a portable ventilator that will serve either as a blower or exhauster. The device, known as the Lamb Air-Mover, is in the shape of a horn with a belled base provided with a compressed-air or steam connection. When air or steam is admitted, it flows through an annular orifice into the horn, where it expands at high velocity and draws along with it a large volume of outside or inside air. Simply by reversing the ventilator it will force fresh or cool air into a working area or exhaust contaminated air. Three models are available: No. 3 has a capacity of 800 cfm with a line pressure of 90 psi; No. 6 moves 3150 cfm, line pressure 70 psi; and No. 10 handles 5160 cfm, line pressure 80 psi. They weigh 6½, 31 and 47 pounds, respectively. The unit shown is removing gas-laden air from an underground vault.

For use in cold-storage warehouses and similar places where trucks are continually moving about there is now available a lightweight swinging door that is said to absorb shock without damage and to possess high insulating properties. It is built of a rubber-impregnated fabric stretched over both sides of a frame of 2-inch rubber tubing. Depending upon the size, it contains from 15 to 25 bladders arranged crosswise between spacers and inflated with air by the aid of protruding valves. The bladders serve to support the door and make it highly flexible. Hinges are attached to steel strips along one side, and a window can be set in the panel so truckmen can see whether or not the track is clear. The cushioned, resilient door is the product of Stic-Klip Manufacturing Company and comes in single and double models of varying sizes.

Slope erosion has always presented more or less of a problem to contractors and highway engineers but may be less of a headache if the claims made by Monsanto Chemical Company for its new soil-conditioning chemical Krilium are true. It was really compounded to increase agricultural production, but when tried on clay, an amorphous formation, the investigators found that it became granular. Instead of absorbing water and baking into a tight crust that chokes plant roots, the latter have access to moisture and oxygen. Embankment grasses grow quickly, covering freshly seeded cut-and-fill slopes with a thick vegetation that stabilizes the soil. The chemical can be diluted in water and applied by sprinkling or spread dry and harrowed into the ground.

Ventilation in coal mines and tunnels can be improved and crumbling of roof and ribs minimized, it is claimed, by the application of a protective coating similar to that used in moth-balling military equipment. R.M. Hollingshead Corporation reports that it has compounded a vinylite resin-based solution which, if sprayed on cloth-covered temporary or permanent shaft stoppings, for example, will form a tight seal against moisture, gases and the loss of fresh air into a blocked shaft. The fluid is applied by standard pressure equipment and is said to be proof against mildew, highly resistant to acids and abrasion, and to survive air shocks and normal abuse. It is also suitable for sealing permanent tile, brick, cinder- or concrete-block or masonry stoppings.

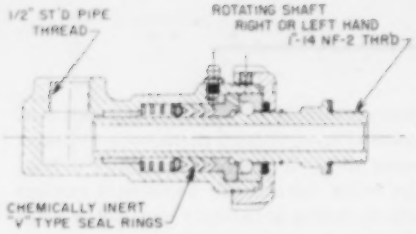
A new machine for automatically square trimming the flanges of drawn stampings has been designed and built by Model Trimmers, Inc., and features four ¼-inch horizontal punch strokes each at an angle of 90° to the preceding one. The punch plate is driven by a 3-hp motor and does not function until the vertical ram is in firm contact with the clearance blocks. The ram is raised and lowered by a 10-inch pneumatic cylinder using air at 85 psi and serves only to hold the work during the horizontal strokes which, being accurately controlled as to alignment, make it possible to square trim contours, notches and tabs, pierce holes and slots, etc. The standard machine has a closing stroke that can be varied from 6 inches to 3 inches by adjusting pulldown rods and is suitable for shells up to 14 inches wide, 22 inches long and 3 inches or less in depth. Trimmers for deeper shells are made to order. The working cycle with the full 6-inch stroke is three seconds. Dies can be changed in from 15 to 30 minutes.



For protection against machine-tool fires there is now being offered a pressurized hand extinguisher that has recently been approved by Underwriters' Laboratories. Called the Redi-Grip, it is made by Stop-Fire, Inc., in 1-, 2½- and

4-quart sizes and discharges a spray of chlorobromomethane that is said to work three times as fast as ordinary extinguishers. Installed directly on an automatic screw machine by a mounting bracket within easy reach of the operator, the 1-quart unit shown in use in the accompanying picture put out a magnesium-chip blaze in 1½ seconds after it was brought into action, according to the company. The chemical is under a pressure of 150 psi, which is built up by attaching a connection from a shop air line to an intake fitting in the removable operating head.

Shown on the next page is a revolving joint for making air or hydraulic line connections with high-speed rotating clutches, chucks, etc. Developed by Barco Manufacturing Company, it features chemically inert "V" seal rings of a new type that are said to have a low coefficient of friction, to be affected negligibly by increases in pressure and to exhibit little tendency to score. It is suitable for use at temperatures as high as 425°F and speeds up to 1800 rpm, or more under certain conditions. The over-

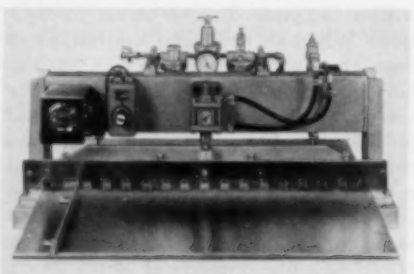


all length of the joint is 6 9/16 inches with wide spacing between bearings and is connected by screwing its threaded steel shaft into the hub of the rotating machine or part. It is obtainable with either right- or left-hand 1-inch 14 NF-2 straight machine threads. A flexible hose connection is recommended at the stationary end of the joint for a free-floating installation.

Air bubbles are serving in place of sand in a lightweight concrete developed by the National Bureau of Standards. A detergent is added to water and cement, causing the batch to foam and to entrain finely divided air cells when mixed in conventional equipment. Up to 45 percent of the volume of the concrete may represent air space.

Paint mixed with an insecticide produced by Dianol Sales Corporation is said to be death to all flying and crawling insects but nontoxic to household pets and human beings. Mixed with all kinds of exterior and interior coatings, including whitewash, the compound remains effective for the life of the paint, normally four years, according to the manufacturer. Called Dianol, the product is being distributed through leading paint, hardware and other stores.

For the manufacture as well as the final closure of large bags, pouches, liners and the like made of heat-sealing materials such as kraft or scrim-backed laminates, cellophane, pliofilm and foil, Pack-Rite Machines, a division of Techtmann Industries, has developed a heavy-duty jaw heat sealer. The Jumbo is powered by a foot-controlled double-acting pneumatic cylinder which, with air at 60 to 100 psi, both opens and closes and exerts a uniform pressure of 19 to 31½ psi on two 38-inch-long flat, serrated or grooved bars. Each of the latter has two heating elements with a combined wattage of 750, or a total of 1500 watts



for the machine, which is provided with a dial thermostat to regulate the temperature within a range of 0 to 550°F. There are two models: one with and the other without a device that automatically controls the sealing or dwell time. The former, which is illustrated, has an electric foot switch that actuates a solenoid valve through which air is admitted to and exhausted from the cylinder within a set interval (0 to 30 seconds), depending upon the thickness and properties of the material.

Permanent, inset highway stripes are coming into vogue. One type, known as Perma-Line, is a thermoplastic material set in a groove cut to a depth of ½ inch by a grinding machine designed for the purpose. The plastic inserts cost more

---

SAUERMAN SCRAPER

Here is a Sauerman machine operating a 3 cu. yd. Crescent scraper on a 700-ft. haul in a deep gravel pit. It produces 120 tons an hour to keep a big plant humming. Entirely operated by one man.

This picture shows a small Sauerman scraper ranging across a waste pile of coal screenings several acres in area and dragging the material down to a washery.

In a Sauerman Power Drag Scraper you find a profitable combination of digging power, haulage speed, long reach, simple operation and economical maintenance. It cuts costs to the bone on jobs of digging and hauling earth or bulk materials distances from 100 ft. to 1,000 ft. or more. It gives years of service.

A Sauerman machine is particularly useful where ground conditions are difficult. It gives good results on such diverse work as the digging of tightly packed gravel, movement of sticky clay, handling of waste material, bulk material stockpiling, removal of sludge from settling ponds and so forth. In digging from a high hill it overcomes the hazards of caving walls.

The operator of a Sauerman machine has finger-tip control of the entire operation. Automatic shifting of the tail end of the machine is provided where desired. Any workman is readily trained as an operator. Power requirement is moderate. Installation and upkeep costs are surprisingly low.

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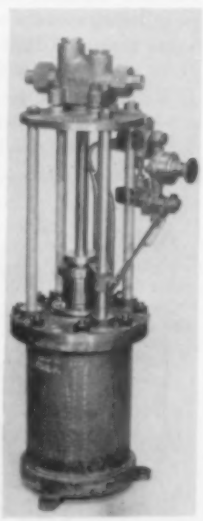
than painted lines, and for the present will perhaps be used mainly to mark traffic lanes at especially dangerous places and around schools and airports. It is claimed that the new material will wear as well as the pavement in which it is embedded.

Record clerks working in a big U. S. Government warehouse in Chicago, Ill., wear miners' headlamps powered by rechargeable batteries. They provide ample light where it is needed and have saved the taxpayer $20,000—the cost of a new lighting system.

Continuous cleaning and circulation of machine-tool coolants is made possible by a separator devised by Sundstrand Magnetic Products Company. The unit consists essentially of a permanent, cylindrical Alnico magnet that is turned slowly by a motor. Mounted over a trough that carries the spent coolant, it picks up the contained grindings and delivers them to a scraper that deposits the solids in a container while the cleaned coolant flows back to the machine's sump for recirculation. Including the container, which is a part of the separator, the unit is 28x10¼x23 inches in size.

Where static hydraulic pressure is required for test purposes, the Madan Air-hydropump can be used to advantage, it is claimed, because it maintains the desired pressure indefinitely and without human effort. It consists essentially of a double-acting pneumatic cylinder and of a hydraulic cylinder which is attached to the piston of the air cylinder. A hollow, stationary ram extends into the hydraulic cylinder and is connected to the liquid inlet and delivery valves. The pumping action results from the reciprocating movement of the piston and hydraulic cylinder, and as the area of the air piston is larger than that of the ram, the pressure in the hydraulic cylinder is increased proportionately. The intensifier will operate so long as the total load in the hydraulic cylinder is less than that in the air cylinder, but when the loads in both are equal then pressure is maintained (no air is used) until the balance is disturbed and the pump starts again. Valves are provided to reverse the direction of the air piston at the end of each stroke and to vary the air pressure upon which the output pressure of the inten-



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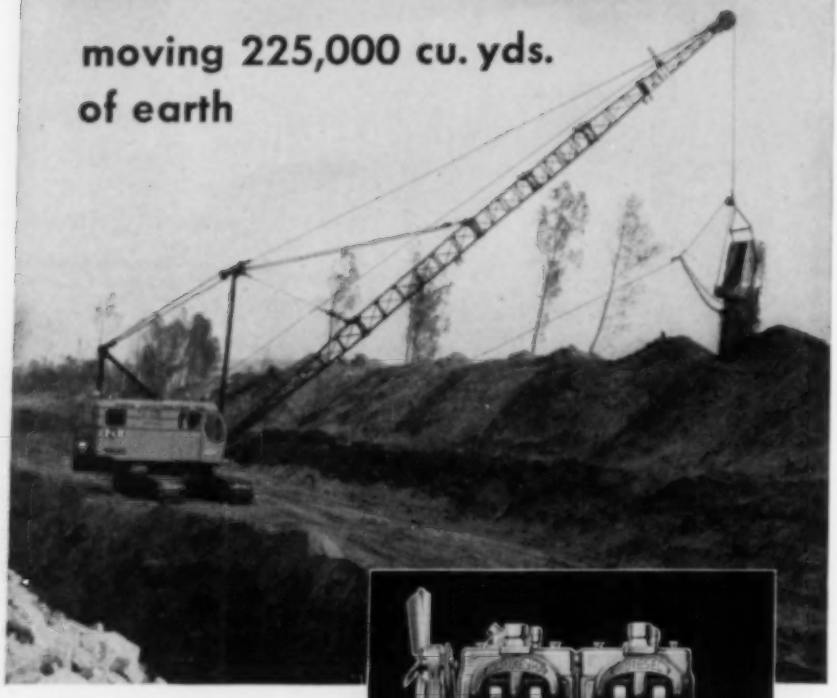

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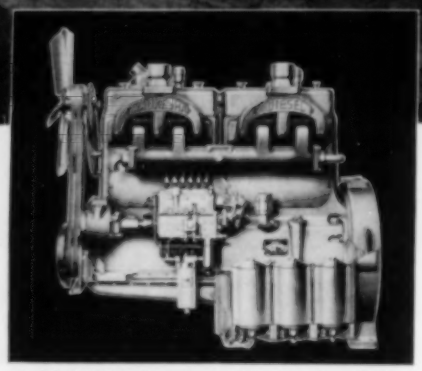

Model 6-WAKD Super-Duty Diesel — six cylinders, 6¼-in. bore x 6½-in. stroke, 1197 cu. in. displacement

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WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN

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sifier depends. With air at from 5 to 100 psi it is possible to obtain hydraulic pressures ranging from 15 to 27,200 psi. Both single- and double-acting units with one and two rams, respectively, are available. The pump shown is of the former type. In addition to testing, Airhydropumps have many other applications such as operating hydraulic jacks in pushing large-size fitted bolts into position in the assembly, for example, of built-up crankshafts and maintaining pressure through hydraulic rams on the rollers of mercerizing and similar machines.

Research with gilsonite indicates that the hard and brittle black mineral can be used as an insulating material. It is said to rank with crushed cork in thermal nonconductivity.

Adding neoprene latex to wood pulp just before it is made into paper gives the latter added wet strength, increases its chemical resistance and generally improves its physical properties, claims du Pont de Nemours & Company.

Steel troughs built in overlapping sections to take care of expansion and contraction make up a shaker conveyor offered by Goodman Manufacturing Company for transporting hot or abrasive materials such as mill scale, silicon carbide and sinter.

Something new in padlocks without key or dial system has been put on the market by Dawes Distributors, Cambridge, Mass. It is opened by a secret number formed by turning four small paralleling wheels each of which has the same group of digits (1 to 9) on the rim, thus making a wide selection possible. It is designed to be used by itself or with a special 36-inch-long steel cable for locking power machines, etc.

"Sorry to disturb ya, sir, but we're movin' the creek"

Books and Industrial Literature

A French compressed air data book, entitled *L'Air Comprime*, has been compiled by Jean Lefevre and published by J.-B. Bailliere et Fils, 19, rue Hautefeuille, Paris, France. The 637-page work is a comprehensive treatise on the theoretical and practical aspects of the production and distribution of compressed air and should be of interest to both manufacturers of pneumatic equipment and users of compressed air. In the first section the author deals with the general principles of the compressibility of gases and their influence on the design of compression machinery. Discussions of all types of compressors are included in the well-illustrated text, which is written so as to be readily understandable by the average compressed-air user.

For engineers and technicians who are confronted with problems relating to the measurement of liquid flow, T. H. Redding has written a book titled *A Bibliographical Survey of Flow Through Orifices and Parallel-Throated Nozzles*. The 196-page volume reviews all aspects of and lists pertinent literature on the subject, with abstracts, from the year 1832. It also contains a valuable technical introduction and an appendix defining terms used in flow-metering practice. Publisher, Chapman & Hall, Ltd., 37 Essex St., W. C. 2, London, England. Price $4.55.

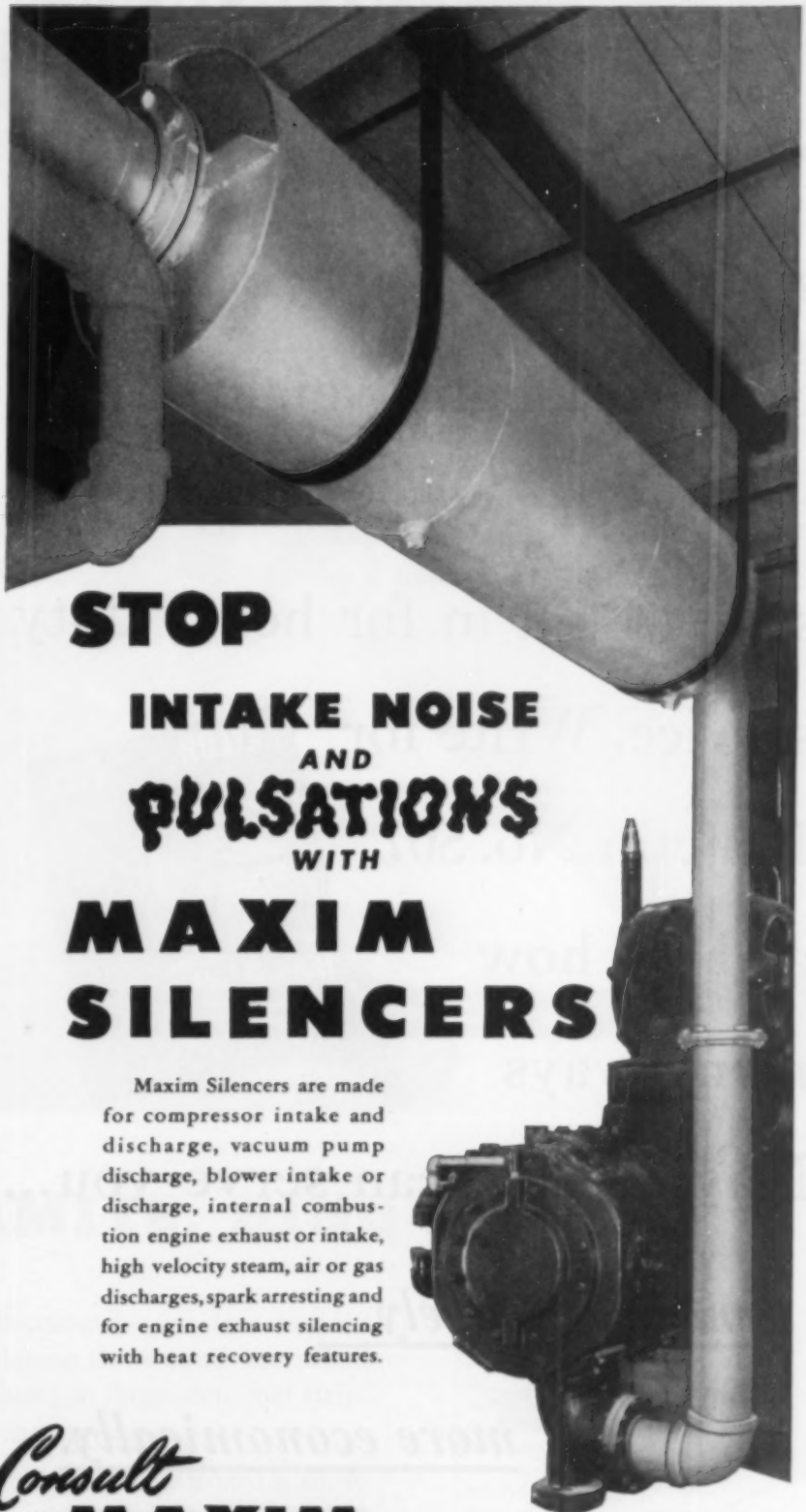
Fred H. Colvin, editor of *American Machinist* for 30 years and author of several books on machinery, believes that there is no reason why an oxyacetylene torch should not have all the romantic qualities for the contemporary poet that the sun or a blazing comet had for the ancients. Calling upon his personal memories of machineshop work, locomotive engineering and a long career which started in 1894, Mr. Colvin brings dignity to such subjects as machinists, draftsmen and maintenance men in his book of poems, titled *Safety Valve*, published by Exposition Press Inc., 386 Fourth Avenue, New York 16, N. Y. Price $2.50.

For users of hydraulic fluids, Monsanto Chemical Company, St. Louis 4, Mo., has prepared a 12-page booklet on its nonflammable Pydraul F-9 suitable for die-casting and glass-drawing machines, presses, hydroelectric turbines and other equipment where a flammable pressure transfer fluid presents a hazard.

Three publications dealing with its complete line of gearmotors can be obtained from Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. Folder B-5296 illustrates and deals with their outstanding features and bulletins 3600-H and 3600-V give complete technical data.

Norton Company, Worcester 6, Mass., has taken steps to conserve our limited supply of industrial diamonds by publishing a 12-page, pocket-size booklet telling users of diamond wheels how they can prolong their life and increase production proportionately. Copies can be obtained from the company without cost.

On the strength of the fact that the national accident frequency and severity rates are greater in maintenance and construction work than in industry as a whole, Allis-Chalmers Manufacturing Company, through its West Allis Works Safety Council, has compiled a *Maintenance and Construction Manual* based on regulations and rules formulated by the concern over a



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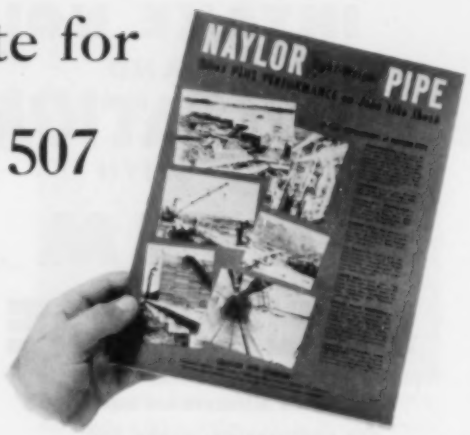

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period of years. Though prepared for its own use, the procedures are more or less standard and generally applicable. Copies of the 56-page booklet—25E7524—can be obtained free from Allis-Chalmers' Health and Safety Department, Milwaukee 1, Wis.

The Manufacturing and Construction Division of Process Industries Engineers, Inc., Pittsburgh 6, Pa., has available a bulletin (No. 51-B) which describes its vacuum-pressure equipment for drying and impregnating electrical equipment, metal castings, lumber, leather, textiles and other materials with varying compounds or liquors.

A 20-page illustrated catalogue on Alnico permanent magnets published by General Electric Company lists stocked sizes and shapes and gives technical information on both cast and sintered magnets as well as on accessory equipment. Write to Carboloy Department, General Electric Company, Detroit 32, Mich., for Bulletin PM-100.

Hankison Corporation, 1501 Beaver Avenue, Pittsburgh 33, Pa., is offering a new 2-page folder describing its Model B-30 Condensifilter, a compact unit made up of a filter, dehydrator and automatic trap. It has a rated capacity of 30 cfm at 100 psi and is designed to provide clean, dry air for operating industrial instruments.

Bulletin 700 recently issued by Spence Engineering Company, Inc., Walden, N. Y., deals with its automatic regulating valves and their five design features. It contains a large cutaway view of a typical valve and shows how its control function can be changed simply by substituting a pressure pilot for a temperature or other type pilot.

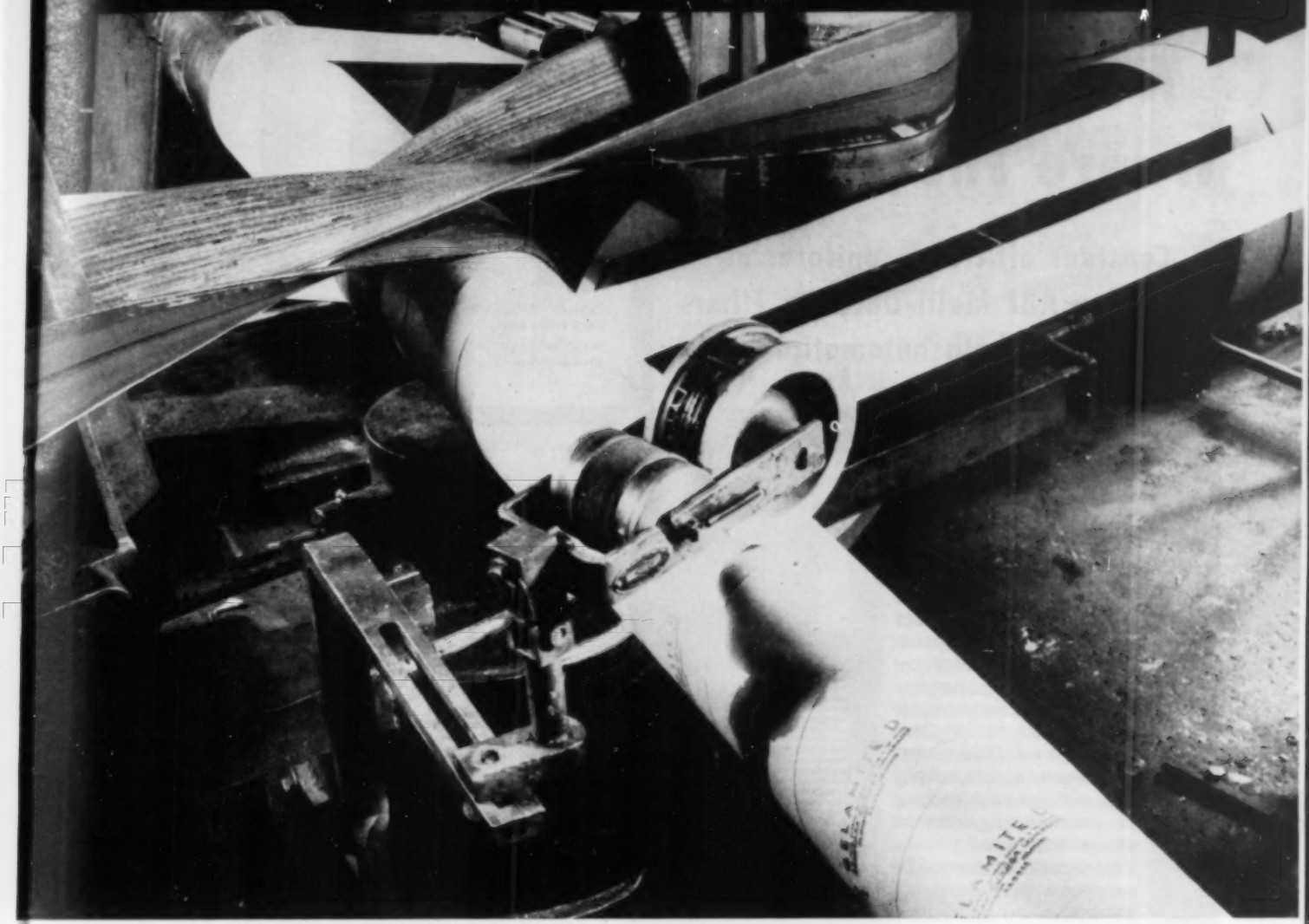
Springs are an essential part in many mechanisms, and to help users select the right one for a given product, Sandvik Steel, Inc., 145 Hudson Street, New York 13, N. Y., has prepared a 20-page multicolored brochure on the subject. It contains a wealth of pertinent information and includes charts that point out the difference in the performance of springs of varying qualities. Copies can be obtained by writing to the company's Sandsteel Spring Division.

In a 15-page bulletin, T-85, The Bellows Company, 222 W. Market Street, Akron, Ohio, gives a detailed description of its standard 10- and 22-inch pneumatic rotary work-feed tables. Numerous installation pictures are included, as well as wiring diagrams and electric hookups with other Bellows air-operated devices. Address your request for the bulletin to W. C. Richards.

The 1952 edition of General Electric's *Instrument Transformer Buyer's Guide* is ready for distribution and can be obtained from the company, Schenectady 5, N. Y. This 94-page publication, designated as GEA-4626E, gives ratings, ASA accuracy classifications and prices of all its indoor and outdoor potential and current transformers, metering outfits, and potential and current portable transformers, as well as other valuable technical data.

Johns-Manville, 22 E. 40th Street, New York 16, N. Y., has recently released two new publications under the titles *Hydraulic Setting Refractories* and *Packings for the Power Plant*. The first is a 12-page illustrated brochure descriptive of the company's Firecrete products for casting special refractory shapes and of its Blazecrete products for gunning and slap-troweling application. The other is a 6-page folder that is designed to serve as a reference guide for packings and gaskets and their services.

PROGRESS IN EXPLOSIVES . . .



DYNAMITE, KING-SIZE

Did you know that dynamite comes in cartridges this big? Hercules pioneered in developing these larger cartridges which make for efficient blasting in large-scale coal stripping, open-pit mining, and quarrying operations.

These king-size cartridges range in diameter from 1¾ in. to 11 in. and weigh as much as 60 lbs. when filled. Spiral-wrapped in Hercules' own plants, they offer advantages in rigidity and smoothness. Other advantages: They are essentially their own shipping containers, are easier to handle and use, and can be stacked like cordwood.

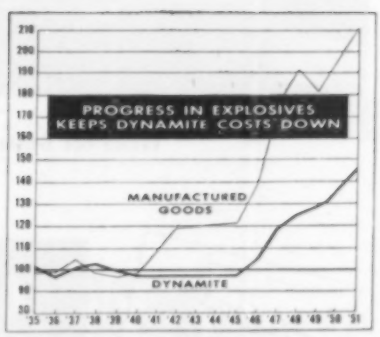


Chart shows relative stability of dynamite prices since 1935, as compared with prices of other manufactured goods. 1935-39 values=100.

HERCULES POWDER COMPANY

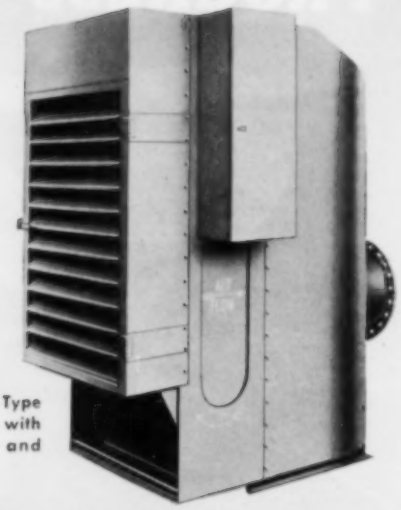
INCORPORATED

Explosives Department, 932 King St., Wilmington 99, Del.

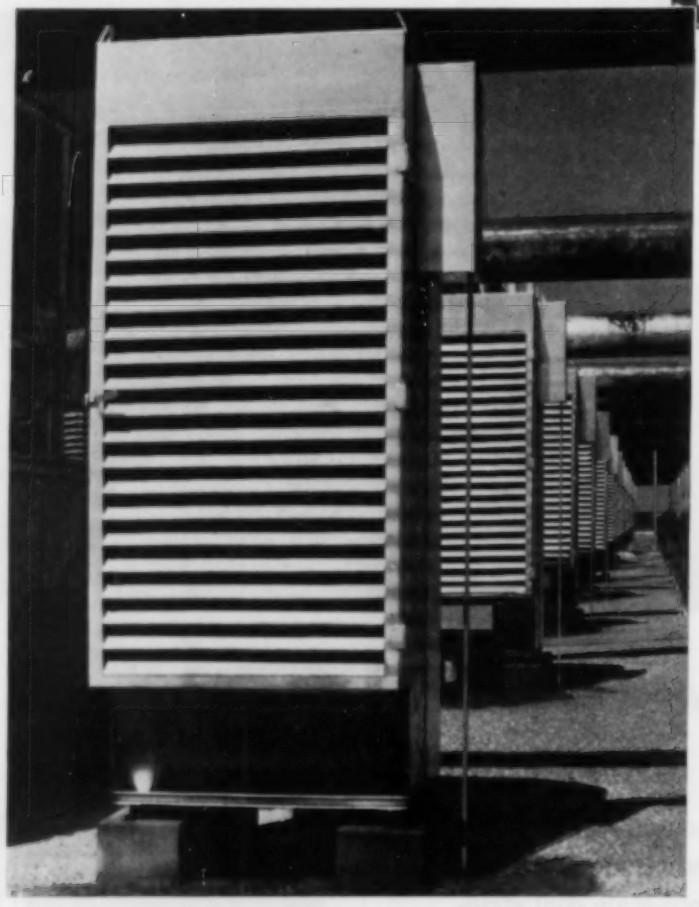
XR52-3

A "MUST" Where There's Dust

Constant efficiency, uniform air delivery—AAF Multi-Duty Air Filters give you both automatically



Typical Multi-Duty Type CMS Filter equipped with weather louvers and plenum chamber.



Fifteen 2400 H. P. Cooper-Bessemer compressors make up this Hanford, Texas, unit of the Michigan-Wisconsin Pipe Line. Farsighted planning saw to it that dust protection was a part of the basic installation. Recognition of proven field performance resulted in the logical specification—AAF Multi-Duty Type CMS Air Filters.

The Type CMS washes its face regularly without the "mother care" of a maintenance man. Because cleaning of its overlapping panels is both automatic and continuous, high efficiency is maintained regardless of dust load, and uniform air delivery results at all times. Periodic inspection and regular sludge removal (without shutdown) are all that's required to keep this filter in fighting trim the year 'round.

For outdoor living, filters come equipped with protective weather louvers and a plenum chamber for attachment of intake. This chamber also has a perforated metal baffle which dampens intake pulsations and distributes air uniformly over the entire filter curtain area.

If you want to write off the threat of dust, permanently, write in the AAF Multi-Duty Type CMS in your next air filter specifications.

Write for Bulletin No. 150.

Today's Best Buy is Better Air!

AAF

American Air Filter

COMPANY, INC.

402 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

take a good look at the Walworth "500 Brinell" no. 225P Globe

IDENTIFICATION DISC: An aluminum marking plate on all Walworth No. 225P's facilitates inventory control and makes reordering quick and positive.

NEWLY DESIGNED HANDWHEEL: Patented air-cooled, finger-fit handwheel affords sure grip even with greasy gloves.

– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

note these 7 Great Features

HEXAGONAL UNION BONNET CONNECTION, DEEP STUFFING BOX AND RUGGED STUFFING NUT: Union bonnet connection eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and reassembled.

OVERSIZE STEM: The high-tensile strength silicon-bronze stem assures long life and protection against wear.

SEATS AND DISCS: Plug type seats and discs of stainless steel, heat-treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.

EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,000 psi.

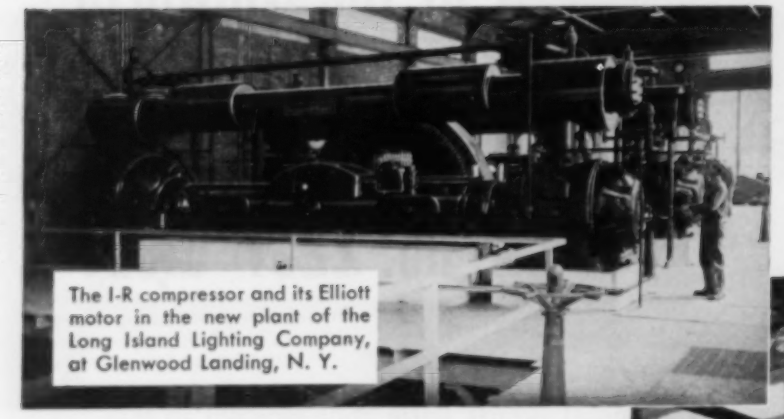
WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

LARGE ELLIOTT MOTOR
...drives gas compressor
for maximum capacity

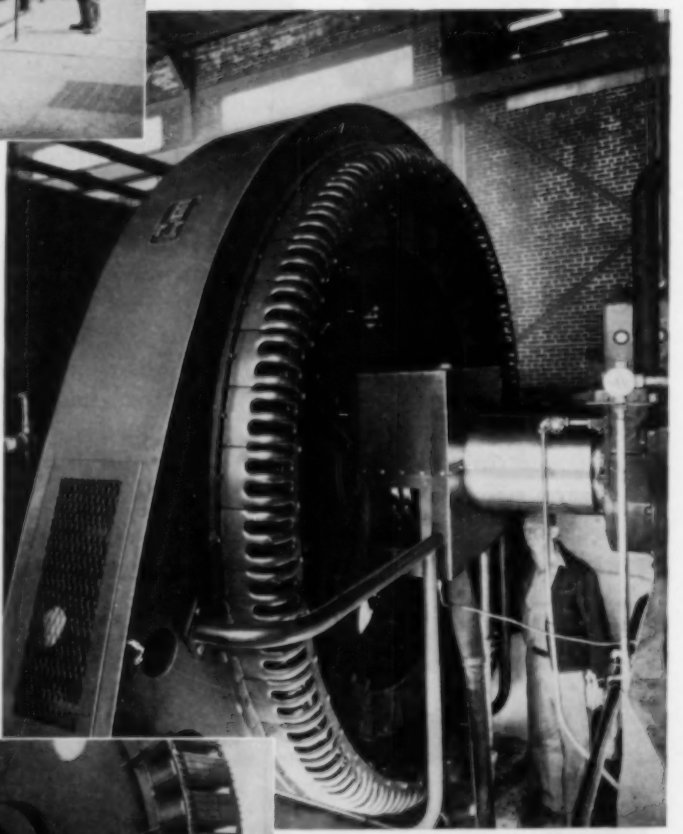


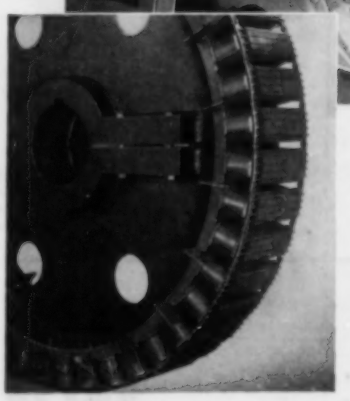
The I-R compressor and its Elliott motor in the new plant of the Long Island Lighting Company, at Glenwood Landing, N. Y.

At the new Glenwood Landing (N. Y.) plant of the Long Island Lighting Company an Elliott 2000-hp engine-type synchronous motor drives an Ingersoll-Rand type PRE-2-4C compressor to serve the rapidly expanding needs of Long Island's home developments.

With the flexibility of Elliott "Fabri-Steel" construction, the motor is designed specifically for its job. The rotor is split to permit mounting on the compressor crankshaft, and engineered with sufficient flywheel effect to prevent the reciprocating motion of the compressor from causing objectionable pulsations in the electrical system. Enclosed collector rings eliminate fire hazard.

The many superior construction details of Elliott low-speed synchronous motors are fully covered in Bulletin 5000-2. Address Dept. C.A.





Close-up of the motor, showing explosion-proof, ventilated collector ring enclosure, with lucite windows for visual inspection.

•

The rotor is of full-split construction, with edge-wound copper strap field coils. Starting winding bars are silver-brazed to the end ring segments for low resistance and for permanent tightness.

L-812

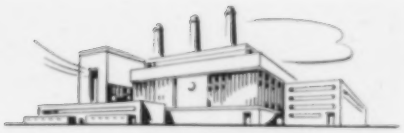
ELLIOTT COMPANY

DEPT. CA

RIDGWAY DIVISION • RIDGWAY, PA.

Plants At: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

District Offices in Principal Cities



Here's REAL ECONOMY in AIR POWER for POWER PLANTS

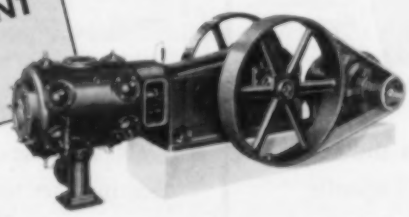
Ingersoll-Rand can supply the right compressor for ALL THREE power plant applications

1. GENERAL SERVICE AIR

XLE Compressors

This new, compact, packaged-design, electric-driven compressor sets new standards of performance and economy in supplying general service air for power plant use. It's a heavy-duty, completely self-contained, two-stage unit producing pressures of 80 to 125 psi. The new "L" Design—with Pipeless Thru-Frame Air Flow, built-in tube-and-finned intercooler, and crankshaft-mounted synchronous motor—saves floor space, cuts installation cost and reduces maintenance.

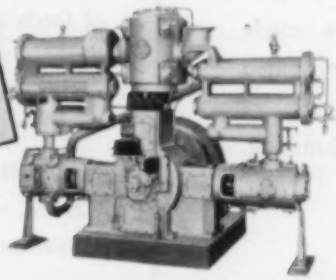
2. INSTRUMENT AIR



ES-NL Compressors

The famous I-R Class ES compressor—with NL (non lubricated) cylinder—is the most dependable and efficient source of oil-free air for operating pneumatic control instruments. The heavy-duty ES compressor meets the most exacting requirements for instrument air systems, where dependability and continuity of service are essential. The NL cylinder is fitted with graphitic carbon supporting and pressure rings, requiring no oil, grease, water, or glycerine for lubrication.

3. SOOT BLOWING



TVH Compressors

This three-stage compressor, with discharge pressures of 350 to 500 psi, has been especially developed for heavy-duty soot-blowing service. Inverted "T" design, with self-contained interstage cooling, assures high over-all efficiency, low discharge temperatures, and smooth running balance. Floor space requirements are reduced and easy accessibility of all parts simplifies inspection and maintenance. Available with direct-connected motor drive.

694-1

● All of these compressors have one thing in common—Ingersoll-Rand's traditional dependability and performance. That's your best assurance of minimum operating and maintenance expense, with important long-term savings that mean real economy in air power equipment. Your nearest I-R representative will be glad to give you complete information on the compressors best suited to your needs.

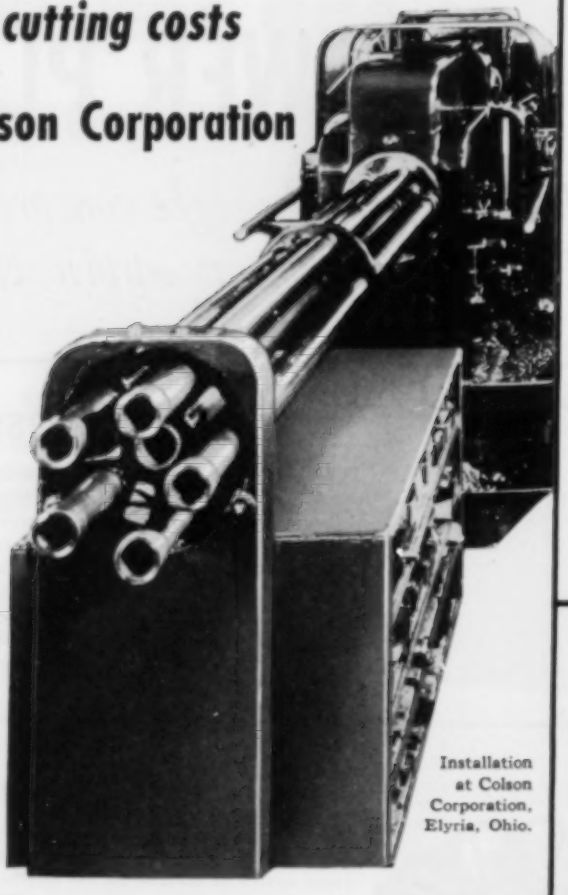
Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Warner & Swasey Automatics

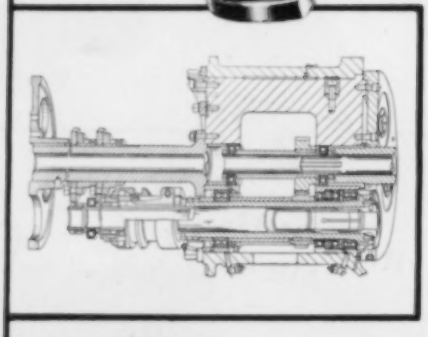
are cutting costs

for Colson Corporation



Installation at Colson Corporation, Elyria, Ohio.

—and their 5-Spindle Automatic Bar Machines are SKF-*equipped*



Here's what Warner & Swasey designers did for one of their customers with advanced 5-spindle automatic bar machines • cut set-up time more than 50% • increased production 7 to 8 times on lots of 500 to 10,000 pieces • made "progressive" set-ups much more practical • made small lots economically practical • provided easy access and interchangeability of tooling • eliminated cam changing.

SKF Double-row Cylindrical Roller Bearings are used on front and rear locations. SKF Ball Thrust Bearings are adjacent to front Bearings. This design gives maximum rigidity through a variety of feeds and speeds without the need of bearing adjustment. Again, the teamwork of machine and bearing designers resulted in advance-designed equipment.

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.— *manufacturers of* SKF *and* HESS-BRIGHT *bearings.* 7325

SKF®

BALL AND ROLLER BEARINGS

IN EVERY INDUSTRY, SKF Puts The Right Bearing In The Right Place

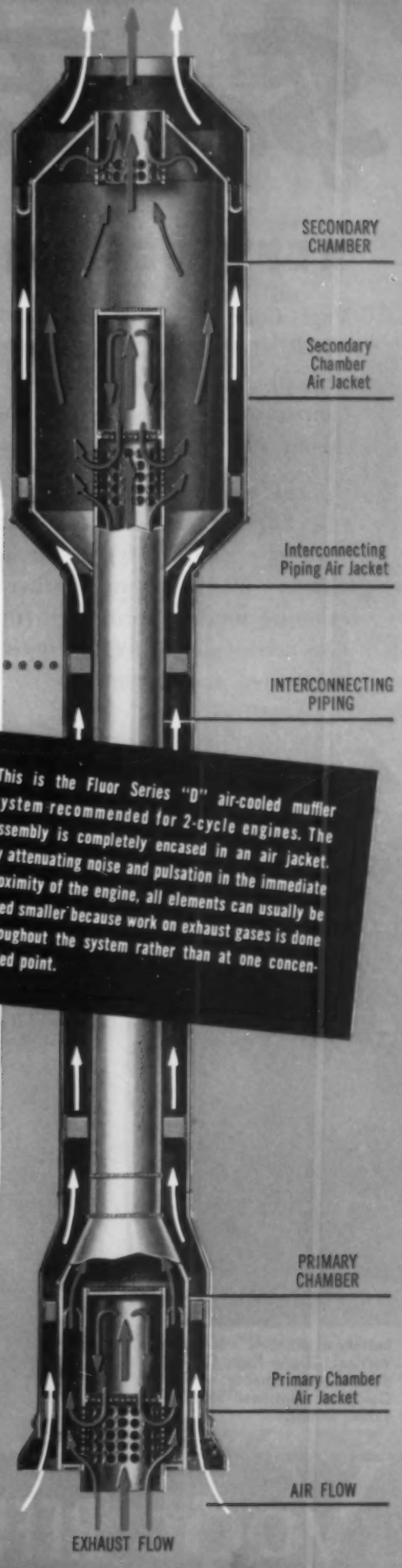
FLUOR air-cooled MUFFLERS

Eliminate exhaust-line insulation
Ventilate engine rooms
Reduce maintenance and repairs
Have longer operational life

The cutaway illustration explains better than words just how Fluor air-cooled muffler systems utilize exhaust energy to accomplish a multiple-cooling action. As exhaust gases are ejected into the atmosphere, a flow of air is also started through the outer air jacket (via the Venturi principle) and expelled with the exhaust at the rate of 3 of air to 1 exhaust, by weight. Depending upon circumstances, this air-reduction ratio often exceeds the specified limit.

The air stream keeps the muffler chambers and interconnecting pipe cool, eliminates the need for exhaust-line insulation, ventilates the engine room and reduces spark hazard. Air cooling prolongs the life of mufflers by reducing corrosion due to heat. And, in many instances, water-cooled manifolds have been replaced with Fluor air-cooled muffler-manifold systems with excellent results.

Fluor Mufflers are available in the Series "D" (shown here), a dual-element system for 2-cycle engines, and in the Series "T", a single-element system for 4-cycle engines. Fluor Mufflers may be purchased with or without air-cooling features, with bottom or side inlets, and for engines in the 150 to 3500 H.P. class of virtually every make and model. For detailed information, write for Bulletin FM-8501.



This is the Fluor Series "D" air-cooled muffler system recommended for 2-cycle engines. The assembly is completely encased in an air jacket. By attenuating noise and pulsation in the immediate proximity of the engine, all elements can usually be sized smaller because work on exhaust gases is done throughout the system rather than at one concentrated point.

FLUOR

Engineers - Constructors - Manufacturers

THE FLUOR CORPORATION, LTD., LOS ANGELES 22, CALIFORNIA
New York, Chicago, Pittsburgh, Tulsa, Houston, San Francisco

Represented in the Sterling areas by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

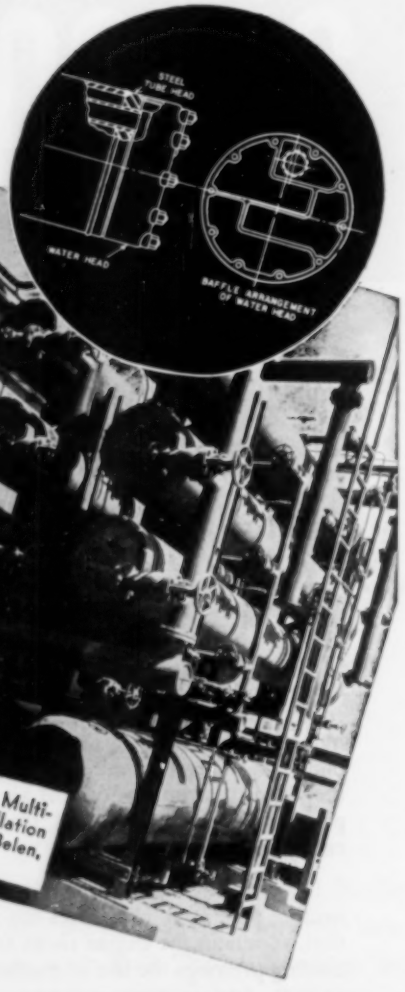
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

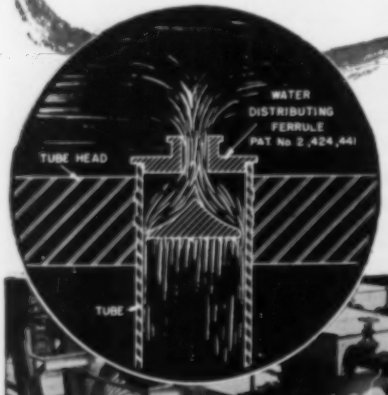
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

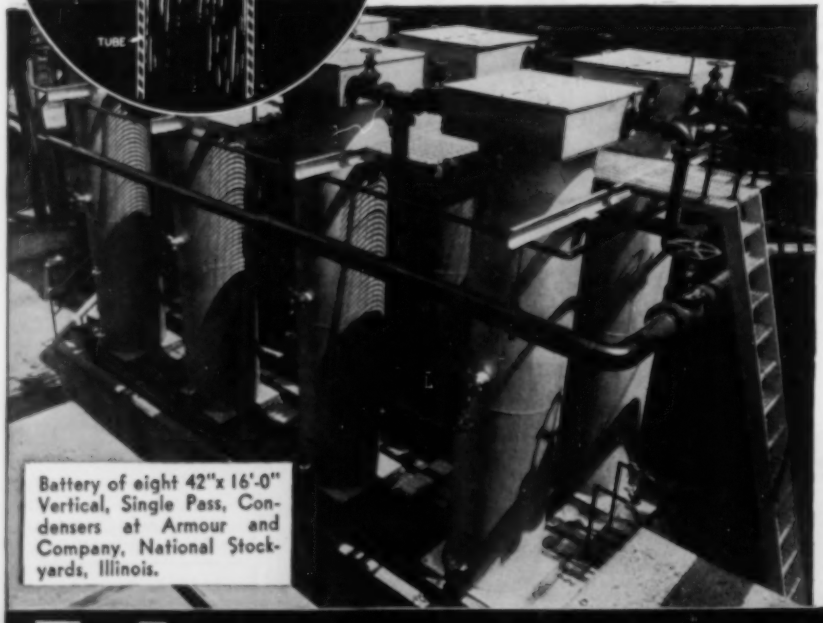


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

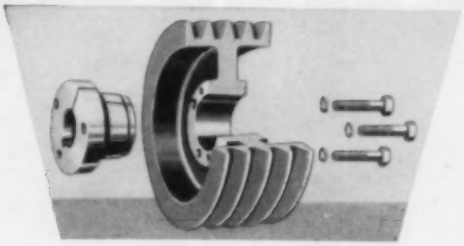
HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

Wood's "SURE-GRIP"



SHEAVES

They're "RIGHT IN THE GROOVE"

Wood's "Sure-Grip" Sheaves—with one-piece, flanged hubs split from end-to-end for maximum grip on the shaft—are *easy to mount, quick to remove* and *interchangeable.* More sheaves used with this hub construction than any other type . . . available in A, B, C, D and E groove sections. Send for Catalog 192.

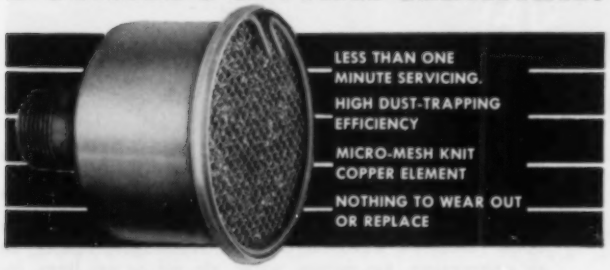
OTHER WOOD'S PRODUCTS
SHEAVES . FLAT BELT PULLEYS . HANGERS . PILLOW BLOCKS . COUPLINGS . BEARINGS . COLLARS . "SURE-GRIP" SHEAVES AND PULLEYS . "SURE-GRIP" STANDARD, SUPER AND STEEL CABLE V-BELTS . COMPLETE DRIVES.

T. B. Wood's SONS CO.
CHAMBERSBURG, PA.

Mechanical Power Transmission Manufacturers—Since 1857.

BOSTON, MASS. • NEWARK, N. J. • DALLAS, TEXAS • CLEVELAND, O.

NEW! Low Cost *Micro-Mesh* DONALDSON AIR CLEANER!


LESS THAN ONE MINUTE SERVICING.
HIGH DUST-TRAPPING EFFICIENCY
MICRO-MESH KNIT COPPER ELEMENT
NOTHING TO WEAR OUT OR REPLACE

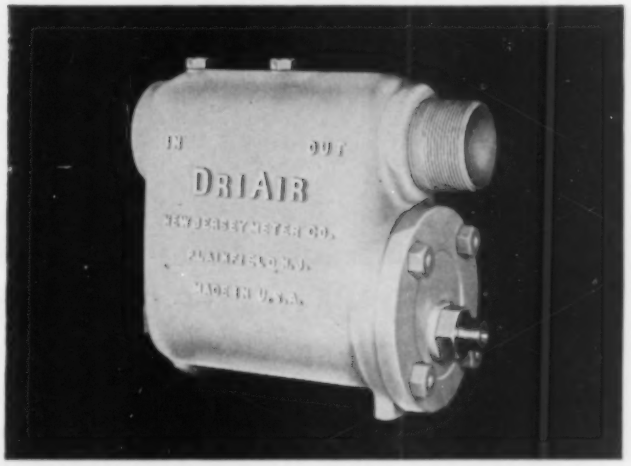
No Tools Required for Servicing
To service, squeeze snap ring together with fingers, removing ring and outer screen. Lift out element . . . wash in kerosene or other solvent. Re-oil and re-insert in cleaner body and replace screen and snap ring. Body of air cleaner need not be removed.

Efficient . . . compact . . . simple to attach and service . . . the new Donaldson Micro-Mesh air cleaner meets every qualification for installations where air requirements are moderate, yet its cost is less than that of oil-washed types. It filters efficiently at any angle, simplifying design problems. Dust entering cleaner is trapped on an oil-wetted filter element, knit from a continuous strand of crimped copper ribbon. Uniform in density, the filter element is placed in the deep-drawn, terne-plate body under slight compression. It will not break down, shift or sag.

Sample Cleaner Sent On Request

DONALDSON COMPANY INC.
666 PELHAM BLVD. • ST. PAUL 4, MINNESOTA

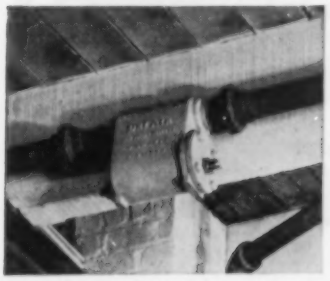
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

OVER 5 TONS
NATIONAL FORGE & ORDNANCE COMPANY
Irvine, Warren Co., Penna.
STEEL MAKERS • FORGESMITHS • HEAT TREATERS • MACHINISTS • MACHINERY AND TESTING EQUIPMENT MFRS.

AIR trap selection and installation for automatic drainage of water from compressed air intercoolers, aftercoolers, receivers, separators and drip points are fully described. Helpful sections include typical installation diagrams, illustrations of the various models of Armstrong Air Traps, their applications and operation, and their materials (cast or forged steel bodies and caps, chrome steel valves and seats, stainless steel interior parts). Physical data and list prices complete the story.

There's enough information here for anyone to make the most effective air trap selection for *any* moisture drainage job, any pressure or capacity range. FOR YOUR COPY, WRITE:

ARMSTRONG MACHINE WORKS
885 Maple Street Three Rivers, Michigan

POSITIVE ACTION

NOISELESS-LONG LIFE

POKORNEY BRONZE Spring Check Valves "Series 1000" meet the need for positive dependable service on air compressors, gas pumps, water, air, oil or gas lines, including Butane and Propane.

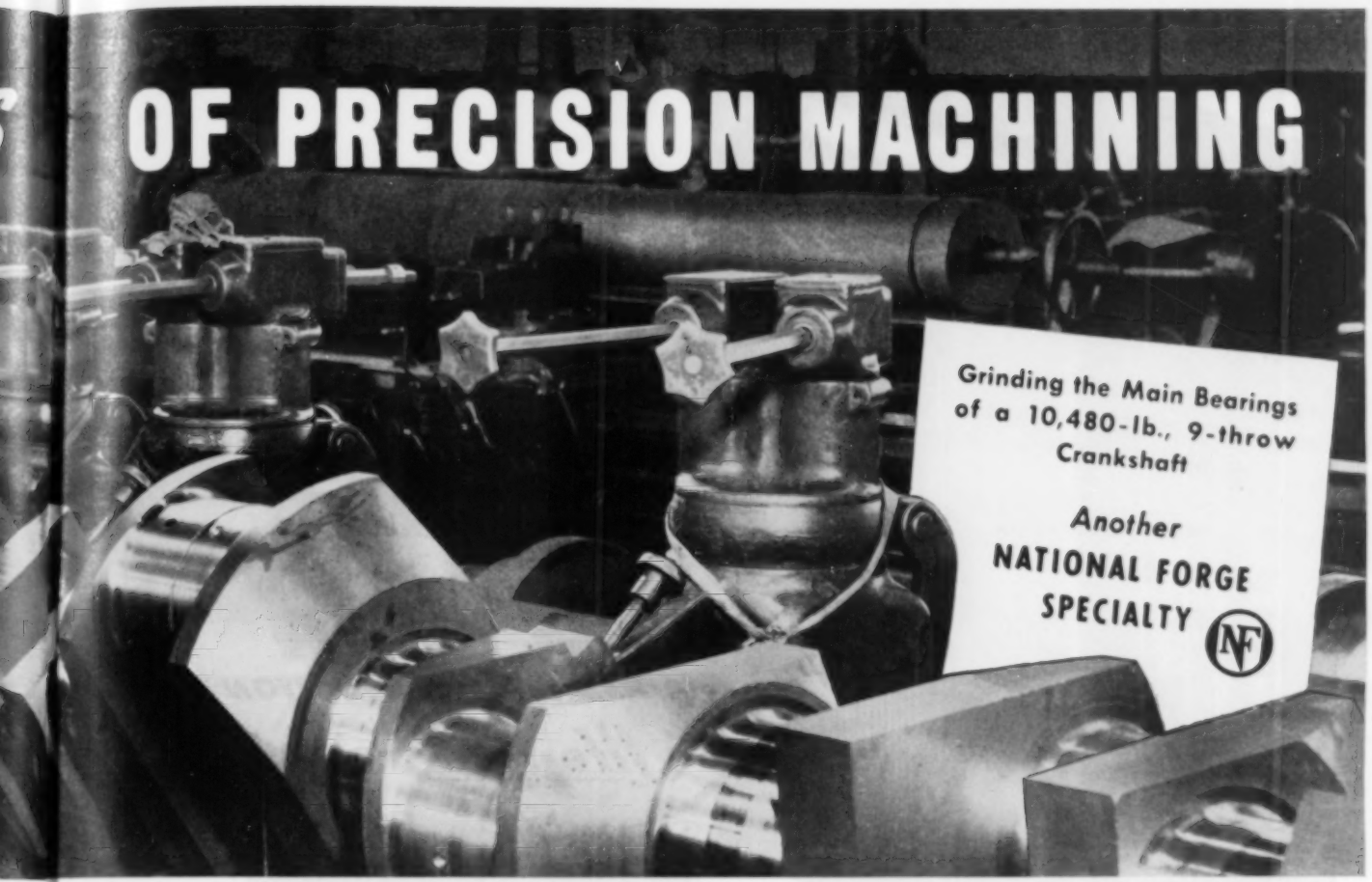
This piston operated, spring loaded, screw cap valve has a special Silicone rubber seat which withstands temperatures up to 500° F, on intermittent service, is resistant to oil, grease and most chemicals. Special discs available for higher pressure water, steam, or air lines. All are easily renewable and give quiet, non-sticking, leak proof operation.

Each valve individually tested and guaranteed for long efficient service at 150 lbs. steam pressure, or 300 lbs. W.O.G. Available in 7 screwed I.P.S. sizes from 1/8" to 1¼". Write today for complete specifications.

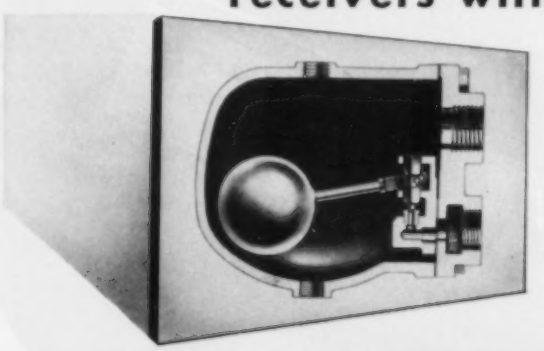
Serving Industry for Over 45 Years.

POKORNEY
MANUFACTURING COMPANY
3117 Clybourn Ave. Chicago 18, Illinois

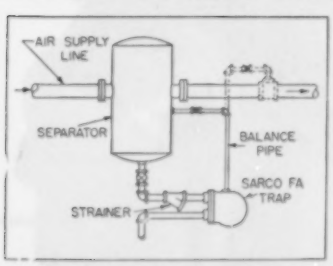
OF PRECISION MACHINING



Drain compressed air receivers with



SARCO FA DRAIN TRAPS



Type FA Trap draining separator.

...also your intercoolers, aftercoolers and separators. These traps automatically release condensate as it forms...without the waste of air that occurs when blowdown valves are used. New technical bulletin No. 5-CA offers many suggestions as to how you can increase the EFFECTIVE capacities of your air compressors. Write today for your free copy. No obligation...of course.

513

sarco COMPANY, INC.
Represented in Principal Cities
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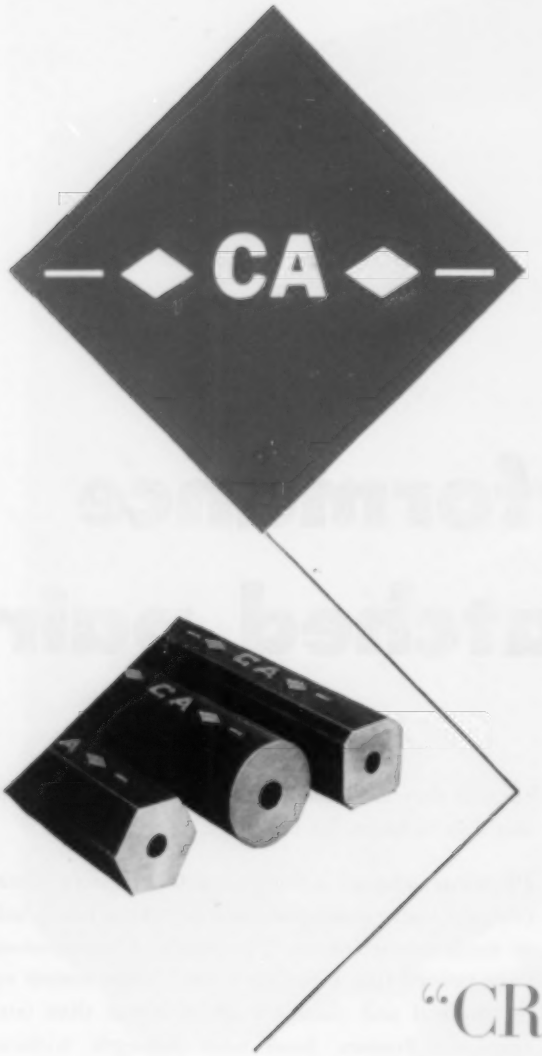

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How TIMKEN® bearings keep down cost of keeping up air pressure

THE Consumers Gas Company, Reading, Pa. relies on these Ingersoll-Rand compressors to provide high pressure air at minimum operating costs. To keep the compressors operating dependably and economically, Ingersoll-Rand mounts the crankshaft on Timken® tapered roller bearings.

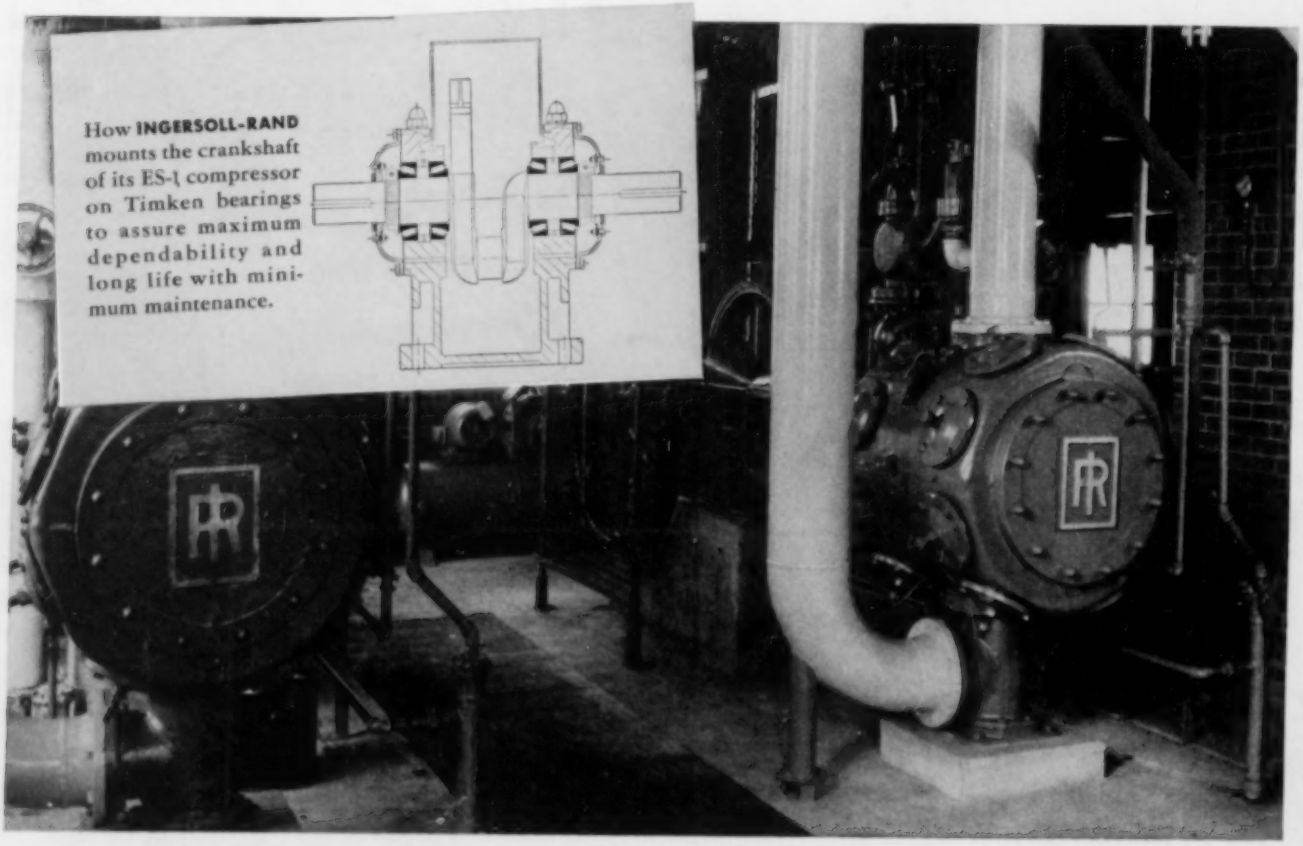
Timken bearings in the compressors hold crankshafts in accurate alignment because their tapered construction enables them to take radial and thrust loads in any combination. As a result, wear on moving parts is reduced, eliminating costly time-outs for repairs.

Because the compressor crankshaft and housing are kept concentric by Timken bearings, closures are more effective. Lubricant stays in—dirt and moisture stay out. Maintenance and lubrication costs are minimized.

The true rolling motion of Timken bearings plus the smooth surface finish of rollers and races virtually eliminate friction. Wear within the bearing itself is negligible. Compressors operate smoothly for long periods of time.

No other bearing can give you all the advantages you get with Timken bearings. Make sure you have them in the machinery you build or buy. Look for the trademark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **INGERSOLL-RAND** mounts the crankshaft of its ES-1 compressor on Timken bearings to assure maximum dependability and long life with minimum maintenance.

DESIGN LEADERSHIP

The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roller ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

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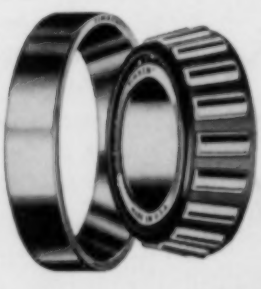

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION